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Cellular Telecommunications Industry Association

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July 20, 1998

Ms. Magalie Salas
Secretary
Federal Communications Commission
1919 M Street, N.W., 2nd Floor
Washington, D.C. 20554

Re: **Ex Parte Presentation**
CC Docket No. 95-116

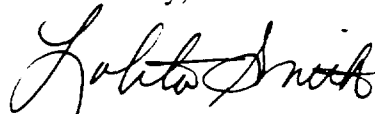
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Dear Ms. Salas:

On Friday, July 17, 1998, the Cellular Telecommunications Industry Association ("CTIA") represented by Michael Altschul, Vice President, General Counsel; Lori Messing, Manager for Technology Resources; and Lolita D. Smith, Staff Counsel, met with Steve Weingarten, Chief, Commercial Wireless Division, Janice Jamieson and Clint Odum, Attorney Advisors, Commercial Wireless Division, and Jeanine Poltronieri, Associate Bureau Chief, regarding the above-referenced proceedings. The parties discussed CTIA's position on the matter and the need for the Commission to act without further delay, in conjunction with CTIA's legal filings in the docket. CTIA also provided the attached document at the meeting.

Pursuant to Section 1.1206 of the Commission's Rules, an original and one copy of this letter are being filed with your office. If you have any questions concerning this submission, please contact the undersigned.

Sincerely,


Lolita D. Smith





CTIA-Building the Wireless Future

CTIA
Report on
Wireless Number Portability

Version 2.0
July 7, 1998

Created by the Number Portability Sub-task Group
on behalf of the
Cellular Telecommunications Industry Association
Numbering Advisory Group

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REVISION HISTORY

<i>Version</i>	<i>Date</i>	<i>Remarks</i>
1.0	April 14, 1997	Initial Publication
2.0	June 8, 1998	Update Publication per industry progression.

1. INTRODUCTION

1.1 Purpose and Scope

The purpose of this document is to characterize the network architecture and operational procedures necessary for the support of Number Portability (NP) in the wireless industry per Federal Communications Commission (FCC) order *Number Portability Report and Order, CC Docket 95-116*. This document represents consensus agreements among members of the Cellular Telecommunications Industry Association (CTIA). This document is applicable to analog Advanced Mobile Phone System (AMPS), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), and Global System for Mobile Communications (GSM) providers (including digital Specialized Mobile Radio (SMR) providers), alike. Differences among Wireless Service Providers (WSP) technologies and implementation aspects are noted where appropriate. Proprietary implementations are outside the scope of this document.

This document focuses only on Wireless Number Portability (WNP), where WNP encompasses numbers (wireline or wireless) porting to a WSP, numbers porting out of a WSP, as well as routing calls to ported numbers (wireline or wireless). WSPs have some fundamental differences with regard to service and network operations as compared to wireline service providers; therefore, certain aspects of NP concepts and definitions have different relevance to WSPs. This document will explain how the wireless solution will account for such differences.

The primary audience for this document is WSPs and wireless equipment and service vendors who assist in the definition, development and deployment of WNP. This document may also benefit other groups such as the wireline industry. It assumes the reader is familiar with the wireless telecommunications technologies.

This document is not intended to supercede any regulatory decisions regarding Number Portability but is intended to describe portability as it involves WSPs.

Revision 2.0 of this document supercedes all previous versions and incorporates the industry progress over the year since the original architecture baseline. It includes enhanced details in switch processing, enhanced details on provisioning and porting processes, further delineation of the MSID/MDN Separation, a definitive Short Message Service recommendation, as well as roaming and billing impacts.

The remaining sections of the introduction present necessary background information to establish a foundation for the WNP architecture, including the following:

- WNP goals,
- NP history,
- NP definitions and interpretations for WNP, and
- WNP assumptions as applicable to this document.

1.2 Solution Goals

The WNP solution as documented here has been developed in accordance with the following significant goals in order to uphold wireless call processing and mobility management:

- Minimize impact on existing networks.
- Continue to allow for roaming and roaming agreements with more than one service provider in any serving area per negotiated business arrangements.
- Do not inhibit the future growth of wireless technology.
- Support the long-term efficient use of numbering resources.
- Support wireless existing and changing service areas without inhibiting competition.

1.3 Definitions

Readers should use the following definitions when reading this document:

- *Default Routing* –
 - (a) Routing on the first six digits of the called Directory Number (DN) without first performing the number portability query (also referred to as *normal routing*).
 - (b) Querying and routing from the donor network to the recipient network when the call has been routed to the donor network without first having been queried.
- *Directory Number (DN)* – any E.164 dialable number assigned to a wireline or a wireless subscriber. A DN can be a 10-digit number in the context of the Number American Numbering Plan (without a country code) or up to 15 digits for an international number (country code included).
- *Donor Network* – the network from which a subscriber ports. If the subscriber has ported more than once, the first network to release the subscriber is referred to as the original donor network. The original donor network is also the original assignee (i.e., NPA-NXX code holder) of the number.
- *Home Serving Area* – the geographic area of coverage provided by a WSP where subscribers may originate and terminate calls without incurring roaming charges.
- *International Mobile Station Identifier (IMSI)* – a 15-digit non-dialable number associated with a specific service provider and unique to each mobile station. It is programmed into the mobile station and used to identify the mobile, its home network, and its country.^{1,2}

¹ *International Mobile Station Identity (IMSI) Assignment Guidelines and Procedures*, Prepared by a Wireless Industry Forum, Sponsored by CTIA and PCIA, Version 1, February 12, 1996.

² Recent international standards activities have altered the scope of this parameter resulting in a pending change to the acronym to *International Mobile Subscriber Identifier*.

- *Local Service Management System (LSMS)* – an SMS responsible for distributing the NP data updates from the NPAC-SMS to the service provider’s NP Database (NP DB), typically owned and maintained by the service provider.
- *Location Portability* – defined by the FCC as “the ability of users of telecommunications services to retain existing telecommunications numbers without impairment of quality, reliability, or convenience when moving from one physical location to another.”³

Location portability should be distinguished from the inherent mobility of wireless communication. Location portability in a wireless environment refers to a subscriber’s ability to retain his/her directory number when moving from the serving area of one home system to another or changing the wireline rate center associated with the mobile directory number. (Refer to Section 1.6 for more details.)

- *Mobile Station (MS)* – “the interface equipment used to terminate the radio path at the user side. It provides the capabilities to access network services by the user.”⁴
- *Mobile Directory Number (MDN)* – a 10-digit North American Numbering Plan (NANP) directory number assigned to a wireless service subscriber. MDNs are a subset of DNs. With the separation of MSID and MDN, MDNs can be international numbers up to 15 digits in length, whereas in the past the MDN could be international number in which the numbering plans including country code were 10 digits or less.
- *Mobile Identification Number (MIN)* – a 10-digit non-dialable number associated with a specific service provider and unique to each mobile station (as an MSID). It is programmed into the mobile station. As it is 10-digits in length and originally used as a NANP-formatted number (e.g., NPA-NXX-XXXX), this number, as an MSID, may be equivalent to the value of a dialable MDN.
- *Mobile Station Identifier (MSID)* – either a 15-digit E.212 formatted International Mobile Station Identification (IMSI) or 10-digit Mobile Identification Number (MIN).
- *Mobile Station ISDN (MSISDN)* – the GSM term for mobile directory number. An MSISDN is an E.164 number. In North America, it is an 11-digit number (country code “1” followed by the 10-digit NANP number). In the case of an international subscriber roaming, it can be up to 15-digits.
- *Mobility* – the ability of a mobile station (and thus subscriber) to move temporarily from one location to another and still obtain telecommunication services (i.e., roaming), and to be in motion while continually accessing telecommunication services (i.e., hand-off).
- *Number Portability Administration Center Service Management System (NPAC-SMS)* – a Service Management System (SMS) responsible for receiving, storing and broadcasting to service providers NP data updates for ported DNs within a region. The NPAC-SMS(s) is owned and maintained by a neutral, third-party.

³ Number Portability *First Order and Report and Further Notice on Proposed Rulemaking*, paragraph 174.

⁴ IS-41.1 Revision C

- *Recipient Network* – the network to which a subscriber ports.
- *Service Portability* – defined by the FCC as “the ability of users of telecommunications services to retain existing telecommunications numbers without impairment of quality, reliability, or convenience when switching from one telecommunications service to another service provided by the same telecommunications service provider.”⁵
- *Service Provider Portability* – defined by the FCC as “the ability of end users to retain the same telephone numbers as they change from one service provider to another.”⁶

1.4 Background

1.4.1 The FCC Order

The FCC Number Portability *First Order and Report and Further Notice on Proposed Rulemaking*, CC Docket 95-116, dated July 2, 1996, mandates that all Commercial Mobile Radio Service (CMRS) providers provide the capability to deliver calls from their network to ported numbers anywhere in the United States by December 31, 1998. Furthermore, the order mandates that these providers offer service provider portability, including support for roaming, by June 30, 1999.⁷

The following are some key excerpts from the original FCC report and order:

- “We require all cellular, broadband PCS, and covered SMR carriers to have the capability of querying appropriate number portability database systems in order to deliver calls from their networks to ported numbers anywhere in the country by December 31, 1998.”⁸
- “We require all cellular, broadband PCS, and covered SMR carriers to offer service provider portability through out their networks, including the ability to support roaming, by June 30, 1999. ... We believe a nationwide implementation date for number portability for cellular, broadband PCS, and covered SMR providers is necessary to ensure that validation necessary for roaming can be maintained.”⁹
- Interim number portability measures are not required for WSPs.¹⁰
- Service and Location portability are not required at this time.¹¹ In addition, changes between wireline service providers and broadband CMRS providers or among broadband

⁵ Number Portability *First Order and Report and Further Notice on Proposed Rulemaking*, CC Docket 95-116, July 2, 1996, paragraph 172.

⁶ Ibid. paragraph 172.

⁷ Ibid., paragraph 172.

⁸ Ibid., paragraph 165.

⁹ Ibid., paragraph 166.

¹⁰ Ibid., paragraph 169.

¹¹ Ibid., paragraph 181.

CMRS providers are considered changing service providers and not service. Thus, service provider portability includes wireless to wireless, wireline to wireless as well as wireless to wireline.¹² As mentioned in the introduction, this document focuses on those scenarios in which a subscriber ports to a wireless provider.

- Customers may need to purchase new equipment (e.g. mobile station) when switching among CMRS providers.¹³
- The issue of regional number portability databases and their content and administration is assigned to the North American Numbering Council (NANC).¹⁴

The FCC has recognized the Location Routing Number (LRN) method of routing as preferred by much of the industry. The FCC, in its original order, established a list of nine performance criteria which must be met by any number portability method:

- (1) “support existing network services, features, and capabilities;
- (2) efficiently use numbering resources;
- (3) not require end users to change their telecommunications numbers;
- (4) not require telecommunications carriers to rely on databases, other network facilities, or services provided by other telecommunications carriers in order to route calls to the proper termination point;
- (5) not result in unreasonable degradation in service quality or network reliability when implemented;
- (6) not result in any degradation of service quality or network reliability when customers switch carriers;
- (7) not result in a carrier having a proprietary interest;
- (8) be able to accommodate location and service portability in the future; and
- (9) have no significant adverse impact outside the areas when number portability is deployed.”¹⁵

On March 6, 1997, the FCC issued its *First Memorandum Opinion and Order on Reconsideration*, CC Docket No. 95-116 to further clarify and rule on several outstanding inquiries regarding NP. The following points are notable:

¹² Ibid., paragraph 172.

¹³ Ibid., paragraph 157.

¹⁴ Ibid., paragraphs 91-102.

¹⁵ Ibid., paragraphs 48-59.

- "...we find criterion four... is, from a practical perspective, unworkable. ... Thus, criterion four does not appear to be necessary in order to implement the statutory definition of number portability."¹⁶
- "We clarify that by June 30, 1999, CMRS providers must (1) offer service provider portability in the 100 largest MSAs, and (2) be able to support nationwide roaming. Although we have not provided a specific phased development schedule for CMRS providers as we have for wireline carriers, we expect that CMRS providers will phase in implementation in selected switches over a number of months prior to the June 30, 1999, deadline for deployment."¹⁷
- "...CMRS carriers need only deploy local number portability by this deadline in the 100 largest MSAs in which they have received a specific request at least nine months before the deadline (i.e., a request has been received by September 30, 1998)."¹⁸
- "CMRS providers must provide number portability in those smaller areas within six months after receiving a request or within six months after June 30, 1999, whichever is later."¹⁹

On August 18, 1997, the FCC issued its *Second Order and Report*, CC Docket No. 95-116. The following paragraphs have particular interest to the wireless community:

- "We adopt the NANC's recommendation that the N-1 carrier be responsible for ensuring that databases are queried, as necessary, to effectuate number portability."²⁰
- "The efficient provisioning of number portability requires that all carriers know who bears responsibility for performing queries."²¹
- "If the N-1 carrier fails to perform the query, the call is routed, by default, to the LEC that originally serviced the telephone number... In light of these network reliability concerns, we will allow LECs to block default routed calls, but only in specific circumstances when failure to do so is likely to impair network reliability."²²
- "Although CMRS providers are not responsible for querying calls until December 31, 1998, we urge them to make arrangements with LECs as soon as possible to ensure that their calls are not blocked. We note that if a LEC performs database queries on default routed calls, the LEC may charge the N-1 carrier, pursuant to guidelines the Commission will establish regarding long-term number portability cost allocation and recovery."²³

¹⁶ FCC *First Memorandum Opinion and Order on Reconsideration*, CC Docket 95-116. March 6, 1997, paragraph 19.

¹⁷ *Ibid.*, paragraph 136.

¹⁸ *Ibid.*, paragraph 137.

¹⁹ *Ibid.*, paragraph 137.

²⁰ FCC *Second Order and Report*, CC Docket 95-116. August 18, 1997, paragraph 73.

²¹ *Ibid.*, paragraph 74.

²² *Ibid.*, paragraph 76.

²³ *Ibid.*, paragraph 78.

- "... when a ported telephone number is disconnected; that telephone number be released or "snapped-back" to the original service provider assigned the NXX." ²⁴

1.4.2 Wireless Industry Studies

In response to the FCC First Order and Report (July, 1996), CTIA released a Notice of Request for Information (RFI) to the telecommunications industry in August, 1996. The purpose of the RFI was to solicit potential implementations of number portability in the wireless telecommunications environment. CTIA received more than one hundred inquiries leading to several substantive responses.²⁵ A Number Portability Open Forum was held October 9-11 to review presentations of the responses and achieve consensus on a common approach.

On January 22, 1997, CTIA released to both the TIA (i.e., TR46 and TR45.2) and Committee T1 (i.e., T1S1.6, T1P1.5) standards committees the *Wireless Number Portability CTIA Standards Requirement Document (SRD)*. The SRD provided initial high-level requirements for WNP on current and future standards. These standards committees began and continue to work on defining switch requirements and protocol standards as appropriate to number portability.

On April 11, 1997, CTIA released the first version of *The CTIA Report on Wireless Number Portability* providing a comprehensive overview of the wireless systems impacts. On June 26-27, CTIA sponsored an open forum to present an overview of the document and ensure telecommunications consensus before moving forward.

CTIA has continued to sponsor work on various number portability issues, including establishing guidelines for Mobile Identification Numbers (MIN) administration and sponsoring a series of Subject Matter Expert (SME) workshops held in San Antonio, September, 1997, and Albuquerque, January, 1998. The SME Workshops dealt with a variety of subjects including care and provisioning, billing, Short Message Service, and NPA-based service impacts. The output of these workshops is reflected in this document update and other discussion forums.

Many WSPs have become active participants in the various committees under the North American Numbering Council (NANC), i.e. the Wireless/Wireline Integration Task Force (WWITF) dealing with WNP impacts on baseline wireline architecture and on the NPAC-SMS.

1.5 Assumptions

The following assumptions are made throughout the WNP architecture:

- This document only addresses Service Provider Portability,
- When a subscriber ports, the subscriber's current terminal equipment may or may not be compatible with the new SP's technology. A subscriber may need to purchase a new mobile station in order to obtain the services from a new WSP. Therefore, a subscriber may or may not port his or her mobile station.

²⁴ Ibid., paragraph 79.

²⁵ Contact CTIA for more information.

- The NPAC-SMS will contain a record for each ported wireline DN and each ported MDN (within the area that it serves).
- Service providers are responsible for maintaining the integrity of their copy of the NPAC-SMS data.
- Each subscriber is identified by at least one unique NANP directory number that will port with the subscriber from one service provider to another.
- Although this document most often refers to the number portability query database as residing on an NP DB, the WNP Solution does not preclude a WSP from locating the number portability query database on another platform such as an STP.
- This document details service provider portability for facility-based WSPs and provisioning aspects related to resellers. (A facility-based WSP is one that operates at least one MSC.)
- Number Pooling, although built upon the Number Portability technology, is outside the scope of this document.

1.6 Aspects of Wireless Number Portability

NOTE: The boundaries of portability, specifically porting between wireline and wireless, was addressed at various forums and has been documented in the LNP Administration (LNPA) Working Group Report on Wireline/Wireless Integration, May 8, 1998. This topic is now in front of the FCC. As a consequence, this section has not fundamentally changed from Revision 1.0.

Because wireless service providers have some fundamental differences in their network operation and services as compared to wireline, differences arise in the design and implementation of wireless number portability. These differences impact how and when subscribers can port to a wireless service provider. To appreciate these aspects, this section presents an overview of these differences, a logical discussion toward explaining wireless portability boundaries, as well as the definition of those boundaries.

1.6.1 Differences between Wireless and Wireline

The differences between wireline LECs and WSPs that impact the definition of portability are summarized in Table 1-1.

Table 1-1 Wireline versus Wireless Calling Aspects

<i>Wireline</i>	<i>Wireless</i>
A directory number is associated with a stationary physical facility (i.e. local loop).	A mobile directory number is not associated with any fixed physical facility.
The subscriber can only be served using the same terminal only at a single location.	The subscriber can be served using the same terminal over a wide geographic area.

<i>Wireline</i>	<i>Wireless</i>
	Mobility is inherent.
Areas of local calling (including rating) are regulated by the states.	Areas of local calling are not regulated by the states. Areas of local calling do not match those defined by wireline providers nor do they match from one WSP to another. Mobile-to-mobile and mobile-to-land calls are not bounded by rate centers.
Incumbent LEC are bound by LATA restrictions.	WSPs may or may not be bound by LATA restrictions.

The FCC definition of service provider portability does not distinguish between wireless or wireline service providers. However, since service provider portability should not disrupt current call rating, the inclusion of a WSP and the added complexities of the above differences must be carefully evaluated.

The definition of location portability infers that the number is associated with a physical, fixed facility. It involves changing rate centers associated with a number which presents significant impacts in rating the call of the originating party when the called party has moved their number to another rate center. However, the landline rate center definitions are not required to rate calls originated by wireless subscribers.

In light of these differences and in order to preserve the integrity of routing and rating of calls to wireless subscribers, whether ported or not, adjustments in interconnection and business agreements (e.g., Points of Interconnection (POI)) may be required.

1.6.2 Geographic Boundaries

1.6.2.1 Wireline Boundaries

In order to understand how wireless can participate in the FCC order without changing the wireline call rating, understanding call rating is fundamental. The concept of "rating" was created by wireline carriers as a method to capture distance related costs in billing. This concept has been adopted by LECs for local calls as well as by IXC's for toll calls. Local carriers accomplished distance rating by defining a *rate center* as a geographic area associated with a single V(ertical) and H(orizontal) coordinate. Each NPA-NXX and its line numbers are associated with a single rate center, often defined as the area served by a single switch (or a combination thereof). The distance related component of rating a call between two telephone numbers is, in essence, based on the difference of the two coordinates of their associated rate centers. Toll and long distance carriers adopted the same concept except that several rate centers may be aggregated to form a *rate district*. The rate district concept was then used to rate calls terminating outside of the local calling area (i.e., inter-city calls).

Today, wireline carriers associate wireless numbers (as defined by NPA-NXX) with a specific wireline rate center for mobile terminated calls. A wireline carrier can rate a wireline-to-

wireless call based on the rate center V&H coordinates associated with calling and called party numbers.

A common assumption for service provider portability is that a subscriber originating a call should not be rated differently because of the called party's service provider or porting status. If a wireline subscriber originates a call, the rating should be the same regardless if the called party has ported to a WSP or where the serving MSC is located. Preserving the rating can be accomplished by WSPs having an interconnection agreements with the wireline SPs. Uniform treatment by wireline providers of calls to wireless subscribers continues to be an issue. Will the rating be based on the original wireline rate center or the fact that the subscriber is being served by a WSP? This issue remains for further study.

Rating calls to a portable wireless number is calculated using the rate center associated with the called party number (not the LRN). WNP does not define any requirement that a WSP obtain an LRN for every rate center associated with their serving area in order to accept a wireline subscriber desiring to port.

1.6.2.2 Wireless Boundaries

WSPs may rate calls originated by mobile subscribers; however, WSPs are not obligated to use the same physical boundaries of wireline rate centers or rate districts. Instead, WSPs utilize the concept of a geographical area referred to as a *Home Serving Area* (HSA). HSAs are typically much larger than the geography defined by a wireline rate center; for example:

- Basic Trading Area
- Metropolitan Service Area
- Major Trading Area

A WSP may define a portion of the above as a HSA or combine several of the above into a larger area. Unlike wireline rate centers which are regulated by the state utility commissions, HSAs are not subject to state jurisdiction (or any jurisdiction for that matter). Thus, the size of the HSA is a business decision of the WSP and frequently differs from one WSP to another.

Subscribers that originate calls within their HSA do not incur roaming charges. A WSP may define different "bands" or calling scopes within or across multiple HSAs which indicate that all mobile originated calls that terminate within the same "band" are rated the same.

1.6.2.3 Mobility versus Location Portability

Wireless users have the inherent ability to move while using their service; it is important to view this as *mobility*, not location portability. Being mobile does not impact the billing or rating for a wireline originated call. Mobility may impact the wireless subscriber through call forwarding charges and/or roaming fees.

Location Portability with respect to wireless is the ability to change Home Serving Areas or change the wireline rate center associated with the MDN. In this case, the wireless billing paradigm is impacted in the same way as with wireline location portability. For the wireless

subscriber, this allows them to use their mobile set in a different area without incurring the roaming fees previously encountered .

1.6.3 Porting To and From

With wireline portability, any movement (i.e., relocation of the physical point of service) is technically considered location portability. However, it is recognized that the wireline implementation of service provider portability can “accommodate” a limited amount of location portability. That is, as long as the serving location is within the same rate center, the NP implementation does not impact billing or rating. Relocating outside the present rate center introduces significant billing and rating implications.

However, once a subscriber ports to a WSP, mobility is inherent. A subscriber can utilize the mobile station independent of any wireline rate center boundary. Furthermore, the subscriber can use the mobile station outside any HSA (subject to roaming agreements and charges). This mobility is transparent whether the subscriber chooses to actually relocate their residence or not.

1.6.3.1 Porting to a Wireless Service Provider

It is assumed that in order to be a recipient network, the WSP must have an FCC license to serve the location of the subscriber. The WSP is also assumed to provide radio coverage over the physical location where service was previously obtained by the ported subscriber. Serving the subscriber via a roaming agreement with another WSP does not constitute eligibility. Finally, WSPs are not required to have switching facilities within the same rate center area as the ported subscriber’s DN NPA-NXX.

Given a WSP is eligible to receive a ported subscriber as defined in the above paragraph, the following criteria must be met to preserve the billing paradigm:

- A wireless subscriber can port the MDN to another WSP as long as the wireline rate center associated with the MDN is geographically located within the HSA of the involved WSPs.
- A wireless subscriber can port the MDN to a wireline SP as long as the resulting wireline SP is geographically located within the wireline rate center associated with the MDN’s NPA-NXX.
- A wireline subscriber can port the DN to a WSP as long as the rate center associated with the wireline number is geographically located within the HSA of the involved WSP.

1.6.3.2 Porting to Wireline Service Provider

A subscriber that ports to a wireline carrier may have originally had their number assigned by a WSP. In this case, calls from other wireline subscribers should still be rated the same as before.

Each wireless number is associated with a rate center from a wireline perspective. The rate center may or may not be the same rate center where the wireless switch is located. Furthermore, the wireless subscriber may or may not reside in the rate center associated with their MDN. Consequently, to maintain consistent rating from the calling party’s perspective,

porting from a WSP to a wireline service provider can only occur when the resulting wireline service is geographically located within the wireline rate center associated with the ported MDN.

Abiding by such constraints does not impact wireline rating. Wireline calls rated on the called party number would continue to be rated the same. Assuming the subscriber has not moved, then from a rating perspective, the situation analogous to a subscriber using the mobile station at the subscriber's residence. Once the subscriber has ported to a wireline provider, that subscriber is constrained to using the telephone number only at a fixed location.

1.7 Critical Dates

1.7.1 Regulatory Mandates

Several dates are included in the FCC order concerning portability implementation. The earliest date involves wireline service provider portability and mandates the LECs to start implementation in the top 100 Metropolitan Statistical Areas (MSA) in 4Q97 with completion by December 31, 1998.

CMRS providers are mandated to complete calls to ported wireline subscribers by December 31, 1998. In reality, CMRS providers could continue to route calls to the donor Local Exchange Carrier (LEC) as normal prior to this date and these calls will complete successfully. More specifically, once an area opens for portability, CMRS providers have the following options:

- (a) implement the ability to query a number portability database and direct the call to the proper serving network; or
- (b) default route the call to the original NPA-NXX code holder, requesting²⁶ the original carrier to query and route the call to the proper network.

The latter can be achieved with or without establishing a business contract with the original code holder. The difference between having and not having a business contract is specified by the service provider performing the query and may be influenced by such aspects as query volume or length of contract. Lack of a negotiated business contract does not imply that calls will not be completed.

The second date involving WSPs is September 30, 1998, 9 months prior to the June 30th, 1999 milestone for wireless number portability. WSPs are only required to provide number portability in switches serving the top 100 MSAs if they have received a specific request for number portability at least 9 months before the deadline. Consequently, all carriers wishing to compete with wireless in the top 100 MSAs must initiate a request to a WSP for deployment of number portability by September 30 1998. Cellular, broadband PCS, and covered SMR providers must make available lists of their switches for which deployment has and has not been requested. This process will ultimately result in the need to identify specific NPA-NXXs for portability, given that a single wireless switch serves a wider geographic area than a single MSA.

²⁶ The receiving provider may offer concessions for pre-arranged business agreements (a.k.a. prearranged routing).

Since the notification to compete would require a formal request, the wireless industry is examining the potential of establishing a third party "clearinghouse" to facilitate the logistics associated with this specific activity. This function of initiating formal local number portability requests is also required for the "smaller areas" beyond the top 100 MSAs after the June 30, 1999²⁷. Industry discussion of the notification process are still underway with the objective of achieving the function at the least cost, industry-wide.

The next critical date for WSPs is June 30, 1999. By this date, WSPs in the top 100 MSAs (which requests for WNP were previously indicated) who have been identified in the notification process must be capable of receiving and releasing porting subscribers and must have all the capabilities required for service provider portability. All WSPs involved in roaming must continue to support nationwide roaming for both ported and non-porting wireless subscribers, in areas both in and outside the top 100 MSA boundaries.

Requests for deployment of WNP in areas outside the top 100 MSAs follow the same procedures established for wireline carriers:

"As in the wireline context, carriers may submit requests for deployment of number portability in areas outside the 100 largest MSAs at any time. CMRS providers must provide number portability in those smaller areas within 6 months after receiving a request or within six months after June 30, 1999, whichever is later."²⁸

1.7.2 Implementation

In order to consider the ability to comply with the FCC mandated dates, the aspect of standards and equipment availability must be considered. Historically, the following intervals have been experienced:

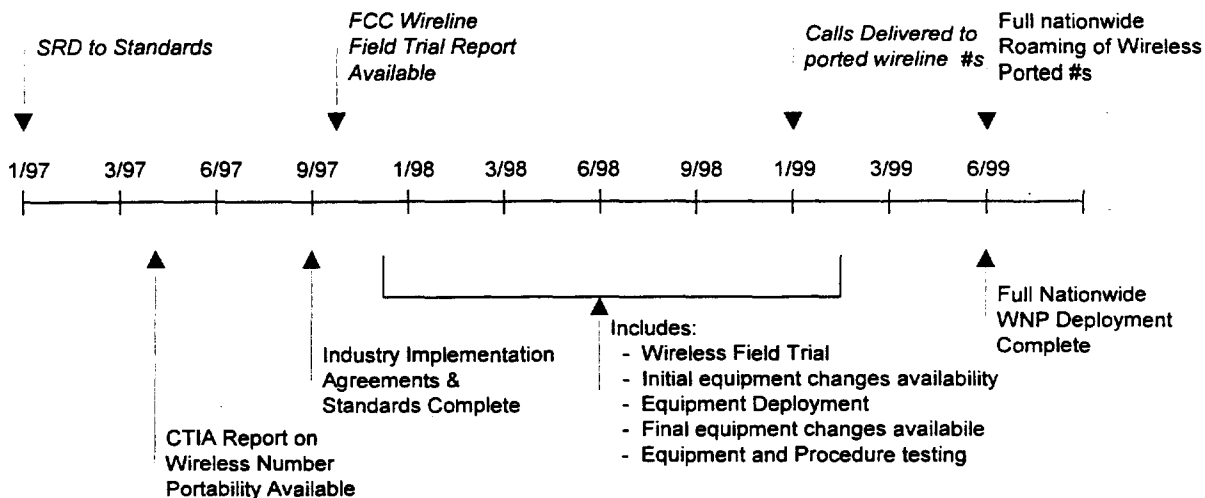
- standards development can take 2 years,
- implementation lead time is 18 months, and
- network wide deployment spans 12 or more months.

Certain activities to some extent can be performed in a parallel manner, and the industry has learned to accelerate activities. Consequently, in the previous version of this report, the timeline in Figure 1-1 was offered for consideration in planning for WNP which shortened various intervals:

²⁷ Ibid., paragraph 137.

²⁸ Ibid., paragraph 137.

Figure 0-1 Potential Timeline Necessary to Meet FCC Mandate (Original)

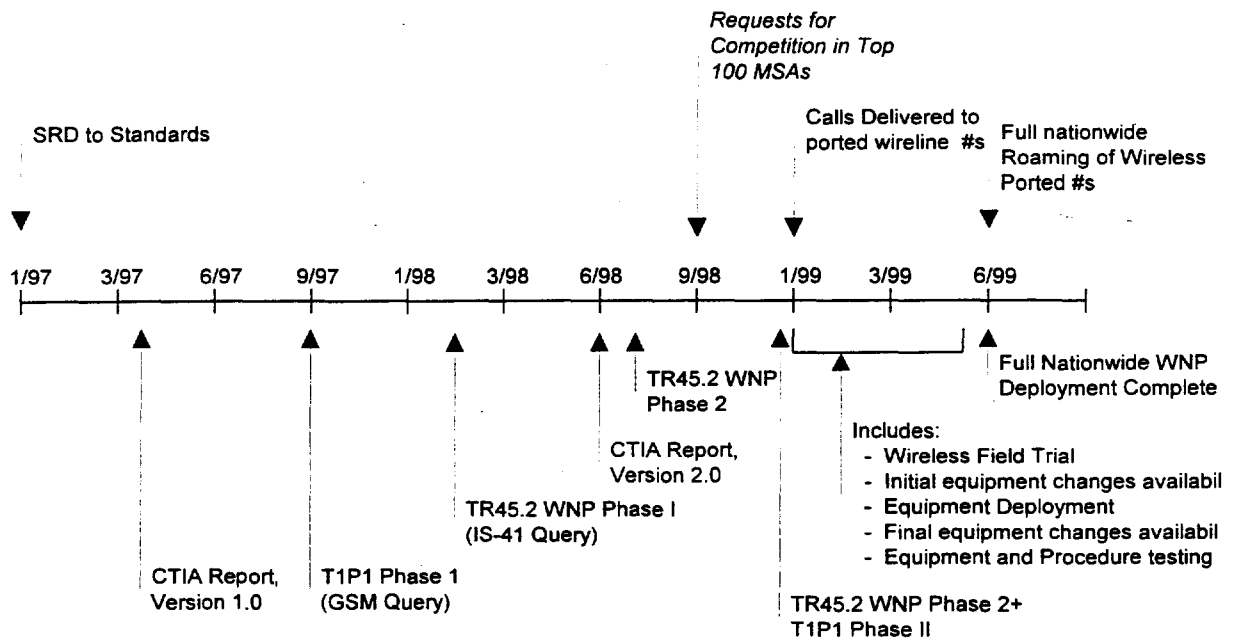


Note: the time points above the line are either actual or derived by the FCC.

Since the Version 1.0 release of this document, various industry activities concerning WNP have occurred, including activities in T1P1 (developing GSM-based PCS 1900 standards), T1S1 (establishing national switching requirements and signaling standards), and TR45 (developing the IS-41 protocol standards).

Not all of these activities were completed in 1997 as originally estimated in Figure 1-1. Therefore, Figure 1-2 reflects the revised standards schedules (for TR45.2 and T1P1) and emphasizes the various activities that must occur prior to June 30, 1999.

Figure 1-2 Potential Timeline Necessary to Meet FCC Mandate (Revised)



The following is a short description for each of the time points:

- *Standard Requirement Document (SRD) to Standards:* This is a completed activity. The initial CTIA SRD on WNP was delivered to TIA, TR45.2, TR46 and T1P1 in January, 1997.
- *WNP Solutions Document:* This point represents the release of this document.
- *FCC Field Trial Report Available for Wireline:* This is the FCC ordered date for a report of the field trial of wireline
- *Industry Implementation Agreements and Standards Complete:* This is a derived date based on the time needed to develop and deploy equipment to meet the FCC dates. This substantially shortens the typical interval to develop standards and come to industry agreement.
- *TR 45.2 WNP Phase 1:* This represents the IS-41 based signaling standards that define the MSC to NP DB query and associated procedures.
- *TR 45.2 WNP Phase 2:* This represents the IS-41 based signaling standards necessary to support the MIN and MDN separation for call processing.
- *TR 45.2 WNP Phase 2+:* This represents the IS-41 based signaling standards necessary to support ancillary wireless procedures, such as Short Message Services.
- Bracketed area illustrates the time frame in which all of the following items must be accomplished in some form:

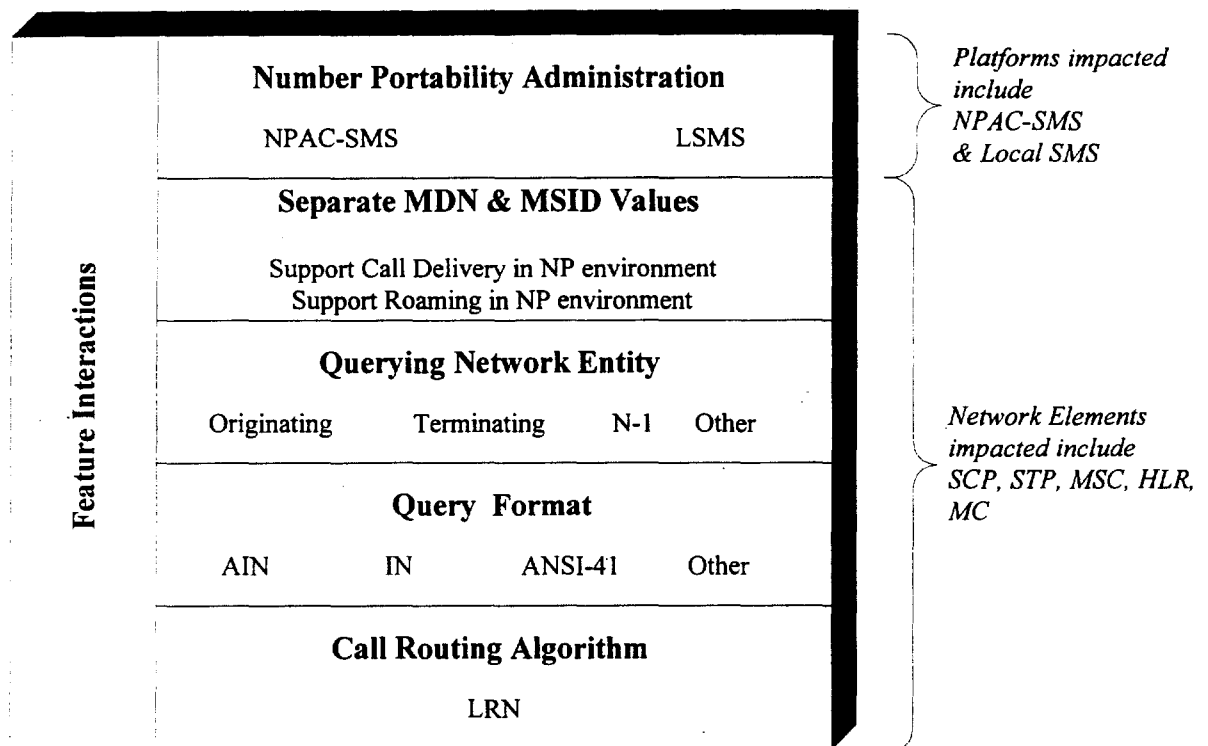
- *Wireless Field Trial:* A field trial of the wireless solution must be made prior to deployment of equipment on any significant scale due to the fundamental impacts of these changes. Due to the limited time available, this trial must be on a limited scope and short time frame. Other forms of testing will also be necessary to prepare for and supplement the trial.
- *Initial Equipment Changes Available:* This date represents the initial availability of any equipment changes to meet the December 31, 1998, date for delivery of calls to ported wireline numbers. This is an evolutionary step to the final wireless solution, not a separate step.
- *Equipment Deployment:* This represents the time required to deploy the needed new equipment, software and changes throughout the industry - a significant task for the wireless industry as nationwide roaming requires all participating carriers to have this capability.
- *Final Equipment Changes Available:* After the initial testing of the equipment and software, a number of adjustments are normally expected. This milestone represents the point in time that the final changes would be available for deployment.
- *Equipment and Procedures Testing:* Even with a field trial, each carrier will need to test the deployment of equipment and procedures within their specific environment to ensure proper operation of maintenance customer care, billing procedures, et al.
- *Calls delivered to ported wireline numbers:* This is the FCC ordered date for wireless to be able to deliver calls to ported wireline numbers within the top 100 MSAs.
- *Top 100 MSA Number Portability Deployment Complete:* This represents the time in which all wireless carriers involved in roaming have deployed the necessary equipment and software to support number portability.
- *Full Nationwide Roaming of Wireless Ported Numbers:* This represents the time in which all needed equipment is deployed and roaming involving ported numbers can be activated. All necessary coordination, services and systems are deployed and operational.

2. WIRELESS NUMBER PORTABILITY

2.1 Solution Overview

Figure 2-1 displays a model of the building blocks for implementing WNP. An explanation of the model follows the figure.

Figure 2-1 Wireless Number Portability Building Blocks



The five building blocks as illustrated in the figure are defined as follows:

- **Number Portability Administration:** This component contains the NPAC-SMS and LSMS which disseminate information regarding ported subscribers.
- **Separation of MDN and MSID:** This component reflects the separation of the MDN and MSID and its significance to wireless registration and call delivery.
- **Querying Network Entity:** This component defines the network entity capable of querying to the NP DB database to obtain routing information. This entity could be in the Originating Network, Terminating Network, N-1 Network (i.e., the next to last network) or some other entity (e.g., a message center, a service node platform).

- *Query Format:* This component defines the syntax of the protocol used to query the number portability database. Possible query formats include IS-41 based, AIN or IN based. There are also references to a pre-IN capability (also referred to as the toll free or 800 capability) which could be implemented in a early AIN or stand-alone environment. Use of a particular query format does not imply nor preclude the implementation of switch processing capabilities. Specifically, use of an AIN or IN based query format does not require, nor preclude, the MSC from implementing AIN, IN or WIN capabilities.
- *Call Routing Algorithm:* This component identifies the routing method by which calls are routed to the subscriber's new service provider (either wireless or wireline). The method is LRN.
- *Feature Interactions:* This component signifies the impacts of the other components on many, if not most, existing wireless features and services.

The right side of the figure maps the major functional hardware platforms to the building blocks. These building blocks drive the following major impacts to today's wireless network architecture:

- (a) Incorporate call routing based on an LRN.
- (b) Move to separate MDN and MSID values.
 - Make the MDN the portable number; keep the MSID as a non-portable number and controlled by the wireless service provider. This separation is essential in order to avoid 10 digit translation in mobile registration and, equally important, in support system processing (e.g., roaming tables).
 - Allow the MSID to be either a MIN or an IMSI.
- (c) Support Global Title Translations (GTT).

The three items listed above are discussed in more detail. Also, Sections 3 (network architecture) and Section 4 (operations and administration) expand on the various points in the figure in greater detail.

2.2 Location Routing Number Call Routing

The Location Routing Number (LRN) is a 10-digit NANP-formatted Network Routing Address assigned to a switch. Of these 10 digits, the first six (i.e., NPA-NXX) are significant for routing a call. For an existing switch, the LRN is assigned from an NPA-NXX code block uniquely assigned to the carrier and from which the switch currently serves.

A Number Portability Database (NP DB) maps every ported number to its serving switch's LRN. A query capable network along the route would perform a query to the NP DB to obtain the LRN associated with the called party's 10-digit DN in order to correctly route the call based on NPA-NXX translation of the LRN. The network then sets up the subsequent leg of the call by sending an ISUP Initial Address Message (IAM) with the LRN.

The concept of the $N-1$ network performing the query to the NP DB is associated with the LRN call routing method. If N denotes the network sequence number of the terminating network in the call path, the next-to-last, or $N-1$, network would identify the NPA-NXX of the dialed number as a portable block and would query the NP DB to retrieve the LRN. If involved, an IXC would typically be designated the $N-1$ carrier. If the wireless service provider does not have a direct connect with an IXC, the call could be routed in accordance with an interconnect agreement with the LEC without changing the $N-1$ responsibility.

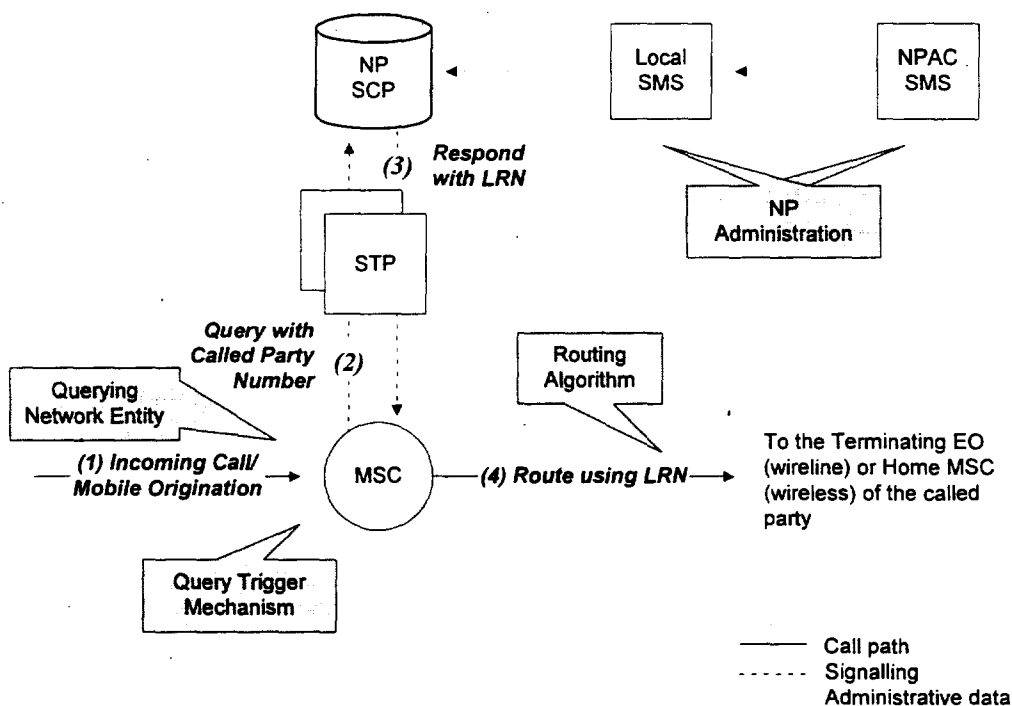
The following scenario should not be over-looked: a wireless carrier provides service in an Rural Service Area (RSA) which is within the same LATA as any one of the 100 largest MSAs; even though that wireless carrier does not provide service within that MSA, it will route calls that terminate within that MSA over a local exchange carrier, thus making the wireless carrier the $N-1$ carrier. Therefore, it is responsible for the correct routing of all calls originating on its system and terminating to the MSA.

The summary, the LRN routing method is characterized by the following:

- (a) It does not require a single unique network address for each ported number. The network address for ported number is associated with the ported-to switch address.
- (b) Call routing remains consistent with current call routing schemes.

Figure 2-2 illustrates a typical LRN routing of a call to a ported subscriber.

Figure 2-2 Routing with a Location Routing Number



For completeness, the figure includes elements not directly involved in call processing, namely the NPAC-SMS and the LSMS.

2.3 Separation of the Mobile Directory Number from the Mobile Station Identifier

2.3.1 Explanation of Separation

Prior to number portability, most North American wireless technologies (i.e., AMPS, TDMA [IS-136], CDMA [IS-95]) based registration, call processing, provisioning, customer care, and billing upon a single number for the subscriber - the Mobile Identification Number (MIN).

If today's MIN was portable, either a 10-digit Global Title Translation (GTT) or an NP DB dip would be required in order to locate the home network of the subscriber *for every registration message from every serving network*.²⁹ Neither of these alternatives is desirable. A dip during registration would increase the query rate on the NP DBs, and not all WSPs are equipped to perform 10-digit GTT in the time frame required. The 10-digit GTT on registration would require provisioning all ported MDNs in all networks supporting roaming.

In WNP, mobile stations will possess two types of numbers: a Mobile Station Identifier (MSID) and a Mobile Directory Number (MDN). The MDN will be a dialable NANP directory number, in the NANP format and will be the portable number. The MSID will be either an E.212 IMSI³⁰ and/or a NANP-like MIN and will not be portable.

With the introduction of number portability, existing TDMA, CDMA, and AMPS subscribers not yet ported will have two numbers (the MDN and the MSID) though both most likely equal to the existing MIN. When the subscriber ports, the MDN and MSID become separate and distinct. The ported subscriber will surrender the MSID to the donor network and receive a new MSID from the recipient network. The ported subscriber's MDN will remain unchanged. The donor network can then freely use this MSID for a new subscriber. It is possible that the same number may be used for an MDN in one network and an MSID (as a MIN) in another network. No adverse impacts because of this situation, however, have been identified.

The GSM standards presently account for separate identifiers: an E.212 IMSI as an MSID for identifying the mobile station, and an E.164 MDN, referred to as the MSISDN. In this way, the MSID and MDN are already separate; the MSID is not based on the MDN in any way. It should be noted that the MSISDN includes the country code; therefore, it is an 11-digit number in North America.

Using an IMSI as the standard mobile station identifier was established as a goal of the wireless industry before the introduction of number portability. Because of this, the CDMA and TDMA

²⁹ Refer to CTIA RFI Open Forum submitted responses

³⁰ *International Mobile Station Identity (IMSI) Assignment Guidelines and Procedures*, Prepared by a Wireless Industry Forum, Sponsored by CTIA and PCIA, Version 1, February 12, 1996.

standards allow for E.212 IMSIs in all mobile stations. Therefore, many CDMA and TDMA carriers may take advantage of the implementation of WNP to introduce IMSIs. However, the entire wireless industry may not flash cut to IMSI.

The industry must support MSIDs in IMSI and in MIN formats. This requires the following:

- IMSI-capable networks and IMSI-capable mobile stations must be capable of supporting both IMSI and MIN MSIDs in order to facilitate roaming on non-IMSI-capable networks.
- Administration of MINs as MSIDs are being addressed outside the scope of this document. Such guidelines and the selection of a MIN administrator are under development. This process is planned to be in place by March 1999.

Variations and implementations of IMSI are being addressed in other forums and are not in the scope of WNP as long as the first six digits of the identifier can be used to ascertain the home network.

2.3.2 *Impacts on Roaming*

Once the MDN and MSID are separated, each switch serving a subscriber with separate parameters must be capable of recognizing these parameters as separate and distinct. This declaration holds true for

- (a) switches that home subscribers with separate MDN and MSID values, as well as
- (b) switches that home for subscribers with equal MDN and MSID values (e.g., not ported) but still participate in roaming.

If the Serving MSC has not been upgraded to recognize the MSID as separate from the MDN, it will most likely use the MSID value for identifying the roaming subscriber (per today's environment) and will not be capable of receiving and storing the MDN. It will, therefore, continue to treat the subscriber's MSID as the telephone number. The consequence is discussed on more detail in §3.3.5.

Accordingly, switches outside of the area of portability involved in roaming must also support the MSID/MDN Separation in order to comply with the FCC statement:

"We clarify that by June 30, 1999, CMRS providers must (1) offer service provider portability in the 100 largest MSAs, and (2) be able to support nationwide roaming. Although we have not provided a specific phased development schedule for CMRS providers as we have for wireline carriers, we expect that CMRS providers will phase in implementation in selected switches over a number of months prior to the June 30, 1999, deadline for deployment." ³¹

³¹ *ibid.*, paragraph 136.

Such support is dependent upon the service provider's involvement (or desired involvement) with roaming. For example, GSM providers may not be impacted until dual mode mobile stations (i.e., GSM with CDMA or TDMA) allow GSM subscribers the capability to roam outside GSM boundaries.

2.4 Global Title Translation for Number Portability

In addition to currently defined uses, Signaling System 7 (SS7) GTT may be used to support routing for the WNP query and for other services impacted by number portability. A 6-digit GTT using Translation Type (TT) 11 is recommended in the WNP environment for delivery of the LRN query to the NP DB. If a WSP does not have GTT capabilities, direct MTP routing to the NP DB to obtain the LRN may be used.

GTT may be used to route messages for various services to the appropriate network element (e.g., recipient switch) when an NPA-NXX of a dialed number no longer uniquely identifies the targeted network element. To support SS7 inter-system message for such services as CLASSSM, Line Information Database (LIDB), Calling NAME Presentation (CNAM), or Short Message Service (SMS), GTT may be available somewhere within the service provider's network (or extended network relying on another provider for portability).

GTT may also be used to route the mobility management messages from the MSC to the HLR (e.g., IS-41 LocationRequest) when multiple stand-alone HLRs have been deployed in the network.

SM CLASS is a service mark of Bellcore.

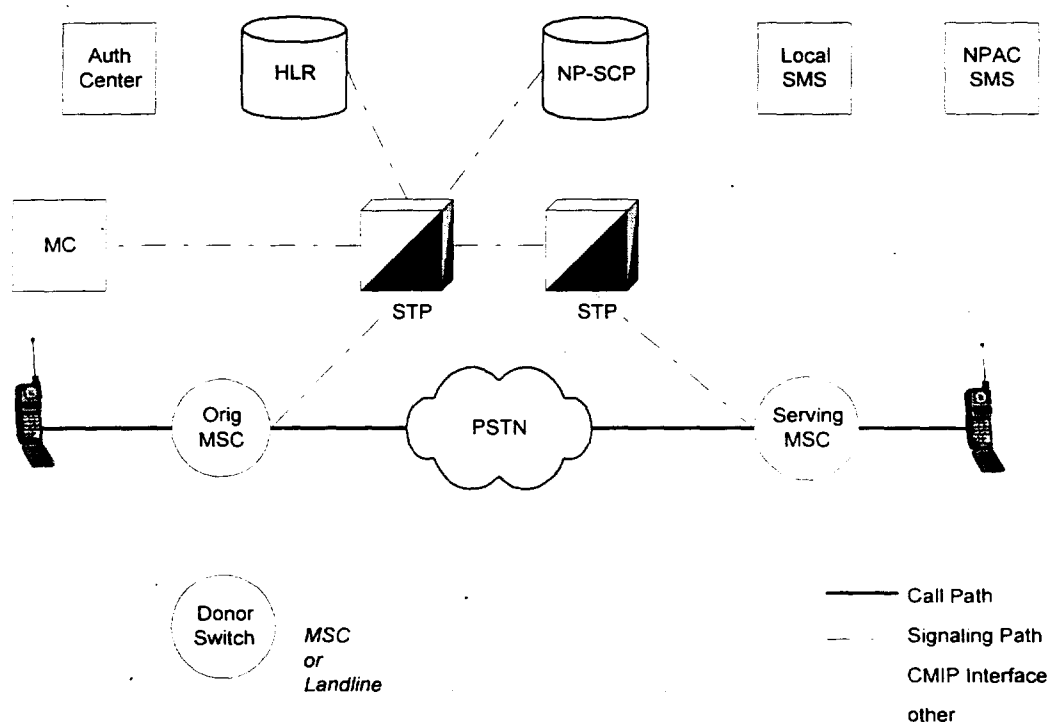
3. THE WNP NETWORK REFERENCE MODEL AND PROCEDURES

This section discusses the necessary wireless architecture (§3.1) and the feature interactions (§3.3) necessary to support WNP. Section 3.2 illustrates the various call routing scenarios via information flow diagrams. Section 3.4 presents some performance considerations.

3.1 Network Configuration

Figure 3-1 illustrates the network elements involved in wireless number portability. Specifically, this reference model only depicts those elements which are impacted by number portability; other elements might exist in wireless networks but may not be directly impacted and therefore, are not included. Other features and services (e.g., Voice Mail) that are not implemented in a standard manner must be studied by each WSP independent of this effort.

Figure 3-1 WNP Network Reference Model



The sub-sections following this figure explain the details of the WNP solution, including a description of each of the elements and the signaling between each of the elements. Although the NPAC-SMS and LSMS are included, Section 4 presents a detailed description of the service management and operating infrastructure.

3.1.1 Number Portability Database

The NP Database (NP DB) is the database accessed in real time by the switches to provide the LRN value for a ported subscriber in order to correctly route a call. It contains the applicable number portability information originally transmitted from the NPAC-SMS to the service provider's LSMS. Each service provider will either own or have access to an NP DB that will include the mapping of ported 10-digit DNs to their associated LRNs.

It is also planned that the NP DB provide the LSMS with ported GTT data for services such as Short Message Service. The GTT data downloaded is expected to represent the address of the gateway STP pair within the ported subscriber's network. This NPAC provided data is used to provision non-final GTT routing tables in the networks other than the ported subscriber's. It is, then, the responsibility of the ported subscriber's network to provision (without aid from the NPAC) the final routing of the message (e.g., final GTT or some other means) using existing systems and procedures.

In summary, the WNP solution presumes, at present, the following data elements, at a minimum, must exist in each NP DB to support routing calls to ported wireless numbers:

- Directory Number
- Location Routing Number

Additionally, an NP DB may contain the Point Code (PC) and Subsystem Number (SSN) for signaling CLASS, LIDB, CNAM, ISVM, and Short Message Service Delivery services to a portable numbers.

3.1.2 Mobile Switching Centers

3.1.2.1 Network Reference Definition

An MSC is a wireless switch. Besides call routing, an MSC typically maintains the Visitor Location Register (VLR). In addition, depending upon the WSPs chosen architecture, the MSC might keep the Home Location Register (HLR). Some providers deploy remote HLRs; others deploy HLRs integrated with the MSC.

The WNP Network Reference Model depicts three types of MSCs: Originating, Donor, and Serving. The Donor MSC is defined in Section 1.3. The Serving MSC is the MSC with which the subscriber is currently registered. The Serving MSC in which a mobile originates a call is also referred to as an Originating MSC. Although not shown on the model, a Home MSC is the MSC which maintains the NPA-NXX relative to the subscriber's number. If the subscriber is registered "at home," the Home and Serving MSC are one in the same. If the subscriber is roaming, the Home MSC receives and forwards the call to the appropriate Serving MSC. Relating to WNP, routing by the LRN might take the call to the Home MSC. Routing from the Home MSC to the Serving MSC is accomplished by use of a Temporary Line Directory Number (TLDN) and is a standard component of wireless architecture independent of number portability.

Routing within the subscriber's service provider network is at the discretion of each individual service provider. For example, a service provider may elect to deploy a single national or

several regional 'gateway' MSCs. With the regional gateway architecture, all inbound calls to the service provider's subscribers would be routed by the PSTN to one of these 'gateway' switches. The service provider would then use internal logic to get the call routed to the appropriate subscriber. This type of architecture is supported by the WNP solution and should have no impact on the other service provider networks.

The signaling for call connection to and from an MSC is discussed in §3.1.6, and the signaling for query from the MSC to the NP DB is discussed in §3.1.7.

3.1.2.2 Configuring for WNP

This subsection describes some of the provisioning aspects necessary for an MSC to support WNP. Also, refer to §3.1.5 and §3.1.6 for more information on setting up the MSC to trigger a query within call processing and data translations.

NPA-NXXs open to portability will be listed in the Local Exchange Routing Guide (LERG) at least 45 days in advance of the first port within the NPA-NXX. The NPAC-SMS will electronically broadcast an NPA-NXX open to portability upon entry into the NPAC-SMS. Industry recommendation is for the LNP NPA-NXX holding service provider to notify³² the NPAC at least 5 days prior to the first port for that NPA-NXX. Whereas the LERG identifies those switches and their respective NPA-NXXs that are identified for portability, the NPAC-SMS identifies those specific NPA-NXXs that contain (or will contain, 5 days hence) ported subscriber numbers.

Current roamer tables will continue to be valid for MINs but should no longer be based on the assumption that the MIN is equal to MDN. Roamer tables should operate on MSIDs, whether MIN or IMSI.

As routing to an MSC is based on the LRN, each MSC shall be assigned at least one LRN. Specifically, the Industry Numbering Committee³³ advises assigning one LRN per LATA boundary to preserve routing and rating across LATA boundaries. As wireless MSCs span multiple LATAs in some cases, it may also make sense to assign LRNs per Point of Interconnect (POI) to also preserve the unique routing and associated rating for call connection and completion. Such an assignment may be based upon interconnection agreements with the LECs. Additionally, there may exist some services (e.g., NPA-NXX based services) for which assigning an LRN specific to routing for that mobility service may make sense.

3.1.3 Signaling Transfer Points

The STP provides SS7 signaling between the network elements per the reference model in Figure 3-1. The STP also provides the Signaling Connection Control Part (SCCP) signaling message translation and routing function. For number portability, the STP SCCP function determines the

³² Notification may be via electronic interface or some other SP-to-NPAC personnel mechanism.

³³ Industry Numbering Committee (INC) *Location Routing Number Assignment Practices*, Issue 102, April 29, 1998.

location of the NP DB and forwards the query to the NP DB (which could be an STP itself). The query response message from the NP DB is returned via the STP.

3.1.4 Signaling

ISUP signaling is currently being enhanced to communicate NP query indicator and associated call routing information to the downstream networks.³⁴ The WNP solution is consistent with the wireline NP solution with regard to the necessary enhancements to the IAM message and therefore, with the Call Completion to a Portable Number (CCPN) enhancements. While this document specifies ISUP for number portability signaling, it recognizes networks which will use MF signaling or rely on third party networks. Both the ISUP and MF trunk signaling are discussed below.

3.1.4.1 ISUP signaling

The LRN approach requires additional signaling information for communicating the query status and routing information necessary for the establishment of call connections to a ported number. Call connections are made using the LRN of the home (recipient) MSC. The query indicator is needed to prevent subsequent switches in the call path from making unnecessary database dips. Finally, the serving switch also needs the dialed number for call termination. ISUP signaling ensures that the necessary additional signaling information will be available to the home MSC.

To explain in more detail, after the MSC queries the NP DB for a call initiation to a ported number and the MSC is ready to establish the call connection, an IAM is formulated with the enhancements documented in Table 3-1.

Table 3-1 ISUP IAM Parameter Settings

<i>IAM Parameters</i> ³⁵	<i>Ported Not Dipped</i>	<i>Ported Dipped</i>	<i>Not Ported Dipped</i>	<i>Not Ported Not Dipped</i>
Called Party Number (CdPN)	dialed DN	LRN	dialed DN	dialed DN
Generic Address Parameter (GAP)	n/a	dialed DN	n/a	n/a
Forward Call Indicator (FCI) MBit	0	1	1	0

(Note: This table only includes those parameters affected by NP.)

If the calling party is a mobile station, the Calling Party Number (CgPN) must be populated with the MDN of the originating mobile station.

If the subsequent switch does not support ISUP enhancements, then the GAP and FCI parameters are not applicable and should not be populated.

³⁴ ANSI T1.660 – 1998, *American National Standards for Telecommunications – Signaling System Number 7 – Number Portability Call Completion to a Portable Number*.

³⁵ ANSI T1.660 – 1998, *American National Standards for Telecommunications – Signaling System Number 7 – Number Portability Call Completion to a Portable Number*.

A subsequent switch upon detecting the FCI as set for “translated number” should not perform an NP query. If the FCI is not set, a subsequent switch may query the NP-DB. Some wireless service providers may arrange for another network (via business agreements) to perform the NP query. In this case, the switch routes the call to the aiding network where the NP query is launched. After this switch performs the database dip, it formulates the IAM message with the dipped settings and routes the call as appropriate.

The home MSC recognizes that it serves the dialed ported number by knowing the LRN in the CdPN is its own LRN. Upon this recognition, it retrieves the dialed number from the GAP parameter. If the dialed number has not been ported but is within a portable number block, the MSC can determine that it is the home MSC by recognizing that the FCI is set and it serves the dialed DN in the CdPN parameters. The home MSC will use the dialed number to terminate the call.

When a donor switch receives an IAM with the FCI not set, it should perform the NP query and route the call to the appropriate switch. Such might the case if there has been some network failure.

Another IAM parameter being discussed in conjunction with wireline number portability (yet not included in the table above) is the Jurisdiction Information Parameter (JIP).³⁶ The JIP is an optional parameter in the ISUP standard. The WNP Solution is not advocating nor opposing the population of this parameter in the outgoing IAM at this time. The use of additional parameters such as the Local Service Provider Identification (LSPI) are under discussion at this time; their impacts are not considered in this document at this time.

3.1.4.2 ISUP Signaling with MF Signaling to the Home MSC

When ISUP signaling is available throughout the call path except at the final trunk MF signaling, the switch inter-working ISUP and MF signaling will need additional capabilities. The inter-working switch must locate the destination switch using the CdPN in the incoming IAM, and then extract the dialed ported number and use it as the called party address in signaling the destination switch. The destination switch will terminate the call using the called party address.

3.1.4.3 ISUP and MF Signaling Inter-working

Call paths that contain a mixture of ISUP and MF signaling may result in redundant WNP queries. After a switch obtains the LRN from the NP DB, for example, it formulates an IAM message. When the IAM arrives at an inter-working switch that switch can only signal the dialed number to the next switch using MF signaling. The switch after the inter-working switch may have to perform a redundant NP query to determine how to route the call. A mixture of ISUP and MF signaling in the call path will require multiple LNP queries to route the call to the serving switch.

³⁶ *Generic Switching and Signaling Requirements for Number Portability*, Illinois Number Portability Workshop, Generic Requirements Issue 1.04, January 20, 1997.

3.1.4.4 Charge Number

If the ISUP Charge Number (CHN) is to be populated with the calling party's number it should be populated with the MDN of the calling party and not the MSID.

3.1.5 *WNP Trigger and Query Types*

Triggers and queries are tightly coupled with intelligent network architectures for the deployment of advanced services. Such architectures include the following:

- Intelligent Network (IN)
- Advanced Intelligent Network (AIN)
- Wireless Intelligent Network (WIN)

Each of these intelligent network architectures utilize specific query protocols and procedures, terminology, and capability subsets. The WNP solution, however, recognizes that prior to the implementation of any of these architectures, specialized trigger and query development may be required. This document recognizes that WSPs will have different implementation needs and that various standards bodies (e.g., T1P1, TR45.2) have a challenge to arrive at the standard trigger and query message (e.g., prior to WIN definition). These qualifiers will become more evident in the following subsections.

3.1.5.1 Trigger Type

Triggers expand basic call handling by allowing additional procedures to be defined and controlled by an external entity. The additional procedures are defined so that when certain conditions are met, the trigger is invoked. A common result of the trigger processing is initiating a specific TCAP query to an external element for information or instructions on how to proceed.

A trigger must be defined and implemented in the MSC in order to launch the query to the NP DB for number portability. However, while the trigger nomenclature is used, these triggers are not dependent on the introduction of any specific intelligent network architecture but can be implemented with specific software coding. Thus, the WNP solution does not specify requirements that any of the intelligent network architectures must be utilized or deployed, nor does it prohibit the use of any. WSPs can implement what is appropriate to their network.

This trigger involves the determination of which calls result in NP queries. It will be a conditional trigger based upon 3 to 10 digits of the dialed number and will be administered at the MSC. If defined in relation to other non-WNP triggers, the trigger for WNP should generally be the lowest priority of all of the dialed number triggers.

Services that involve persistent transactions³⁷ may be impacted with the implementation of WNP. A WNP trigger may be encountered in some persistent transactions. If the persistent

³⁷ A persistent transaction is an intelligent network process that is maintained after the initial message exchange. An example might be the Auto Redial service which can be invoked after encountering a busy signal to monitor the busy line and receive a call back when the line is available.

transaction must be closed before an WNP query to the NP DB can be launched, these services may not function properly.

3.1.5.2 Query Type

The WNP query is a TCAP message sent to the NP DB as initiated by the WNP trigger discussed above. Upon satisfying all of the trigger conditions, the MSC sends the query with the 10-digit DN. If the number is ported, the NP DB responds with an LRN for that DN. If the number is not ported, the NP DB typically responds with the DN.

Various intelligent network architectures offer different query message types for communication between the switch and the database. Also, WSPs can choose to implement any of the protocols suitable to their networks and their chosen NP DB platform. WNP does not pose any requirements as to a specific query type.

The following is an overview of the options:

- *IN-based Protocol:* The switch initiates a “Instruction Start” message and awaits the “Control Connect” response. The IN based protocol is implemented in wireline portability and is anticipated to accommodate WNP without modifications.
- *AIN-based Protocol:* The switch initiates a “Info Analyzed” message and awaits the “Analyze Route” response. The query message indicates the CdPN as well as the Calling Party Number (CgPN) and bearer capability (e.g., the call type is voice). Though the latter two parameters are not required for portability, they are mandatory in the “Info Analyzed” message.
- *IS-41 Protocol Query Message Standard:* The MSC initiates a *NumberPortabilityRequest* Invoke and awaits a *NumberPortabilityRequest* Return Result. The invoke message indicates the *Digits(Dialed)* (10 digits in total). As an option, the MSCID, the MSID, and the Calling Party Number parameters can be included. The return result includes the *RoutingDigits*, if the number is ported, or no parameters, if not ported.
- *PCS Query Message Standard:* The MSC initiates a “provideInstruction:Start” message and awaits the “connectionControl:Connect” message response as defined in ANSI T1.708-1997. The Service Key (SK) parameter in the query message is populated with the 10-digit called party number. The Routing Number (RN) parameter in the response message is populated with the LRN if the contents of the RN are not the same as the called party number.
- *WIN-based Protocol:* A WIN-based protocol could be defined for querying the NP DB. It would include the DN and would be capable of returning the LRN, at a minimum. WIN, however, is an intelligent network architecture currently being defined. The WNP query will be required in advance of WIN incorporation in standards. Therefore, the WNP query may or may not be WIN-based.
- *Other:* A message could be defined using a special arrangement.

3.1.5.3 Automatic Code Gap

The MSCs are not typically equipped with Automatic Code Gap³⁸ (ACG) capabilities as they do not normally trigger an SCP (in today's wireless environment). However, NP DBs are required to support mechanisms to control overload situations via ACG. ACG Indicators parameter of TCAP indicates the cause for applying an ACG control, the time duration for the ACG control to be in effect and the time interval (gap) between ACG application. Consequently, MSCs should recognize and react appropriately to such indications in the TCAP message from the NP DB.

As ACG is mainly being suggested so that a WSP's MSC can query a database also serving a wireline provider and deployed in a wireline environment. Therefore, the WNP Solution suggests that the ACG implemented for the wireless query be in line with the wireline ACG standards and requirements for Number Portability.

3.1.6 WNP Call Processing

The MSC must be able to process a call destined to a ported subscriber. The procedures for doing so apply for calls received from trunks as well as calls originated by a mobile station. While the procedures could be argued as being "implementation dependent", these procedures used in the MSC are closely related to assumptions regarding

- the process of porting.
- provisioning HLR, and
- network performance impacts.

The wireless industry has expressed desire that the porting of a number occur in a timely basis; namely, in two and one-half hours or less. Included in this interval is the notification of the porting between two service providers, the coordination of the porting of the number in the NPAC, and the provisioning of the subscriber profiles in the respective HLRs.

It is assumed that once a subscriber ports, the new service provider has appropriately updated their HLR. Ideally, the donor wireless service provider should remove the number from their HLR upon porting. If this latter statement is assumed, some efficiency gains can be realized with respect to call processing. The efficiency gains pertain to the proper handling of the following:

- Vacant Numbers – numbers associated with a WSP for which there is no active subscriber, including numbers being aged. These numbers are provided intercept treatment when a call is attempted to any of these number.
- Ported-out Numbers – numbers no longer associated with the donor WSP as the number has ported to another provider. Calls to these numbers should be routed to the current service provider.

³⁸ ACG is sometimes referred to as Automatic Call Gapping, however the TCAP standards terminology for the control is Automatic Code Gap.

- Aging Ported-in Numbers – numbers that were ported in to the provider but which the subscriber has terminated service (not ported-out). The recipient provider will "age" the number by providing intercept treatment for a limited time period.

Of key consideration is the order and handling of the NP Query³⁹ relative to the HLR Query.⁴⁰ The results of the first query impacts the processing aspects and potential error treatments of the second query. Also, call processing is impacted by whether call processing was a result of a mobile origination or a call from an incoming trunk.

For additional information, a chart is provided in Appendix 1 which details call processing relative to performing either query first. This chart was developed as supporting information only and does not supercede this text.

3.1.6.1 Conditions for the Number Portability Query

The NP Query should be launched if the NPA-NXX of the dialed DN matches an NPA-NXX open for portability as provisioned in the MSC.⁴¹ A WSP might also provision the MSC to send a NP Query based on other conditions (e.g., interconnection agreements). For incoming trunk calls, the Forward Call Indicator M Bit is also used to determine whether to launch the NP Query. If it is set indicating that a query has been performed, then another one should not be launched.

3.1.6.2 Processing Calls from Incoming Trunks

When a call is received from a trunk, the MSC should perform the HLR Query prior to the NP Query, if required. If the called NPA-NXX is open to portability, it is expected in most cases that the *N-1* carrier will have performed the query and set the FCI M bit, thus eliminating the need for the MSC to launch an NP Query. If that is not the case (as in default routing or if the trunk interface was MF), then the MSC should perform the HLR Query first. If a profile is present, then the call should be completed as normal. This is predicated on two important assumptions:

- Most numbers in a NPA-NXX assigned to a WSP will not have ported out.
- Numbers that have ported out are removed from the donor's HLR in synchronization with the NP database(s) being updated.

If the HLR Query response indicates no profile exists for the called party, then an NP Query should be performed. The NP Query will result in one of the following conditions:

- *No LRN is returned.* The number has not ported and is currently served by the MSC. Since no profile exists on the HLR (per the HLR Query), vacant code treatment should be provided.

³⁹ The term "NP Query" is used generically in this section to refer to the query to the Number Portability database.

⁴⁰ The term "HLR Query" is used generically in this section to refer to the appropriate mobility location query message (e.g., IS-41 Location Request).

⁴¹ This condition rules out querying on such calls as operator services calls and N11 (e.g., 911).

- *The LRN of the MSC that launched the NP Query is returned.* The number is currently served by the MSC. Since no profile exists on the HLR (per the HLR Query), vacant code treatment should be provided.
- *The LRN of another switch is returned.* The MSC should formulate an ISUP message that contains a Generic Address Parameter, set the Forward Call Indicator as "dip performed," and forward the call.

It is possible that, in the future, more numbers may be ported out of an NPA-NXX than are served (such as the case in number pooling). At that time, it may be more efficient to perform the NP Query first for incoming trunk calls, but the efficiency gain is realized only if the *N-1* carrier does not perform the query. Otherwise having the flexibility to perform the NP Query first rather than the HLR Query provides little benefit.

3.1.6.3 Processing Calls Originated by Mobile Stations

For mobile originated calls, there are benefits to launching the NP Query prior to a HLR Query in some cases and benefits to reversing the order in other cases.

Consider the situation where relatively few subscribers are ported-in from another carrier's NPA-NXX. Performing the NP Query first would determine the correct service provider and only then, if the subscriber is served by that carrier (i.e., the NP Query returns the LRN of that carrier), would the HLR then be queried. If the HLR Query were performed first, all calls against that NPA-NXX would result in an HLR Query with the vast majority not having any HLR profile present. This could cause a serious performance degradation on the HLR.

On the other hand, if a majority of subscribers in a NPA-NXX have ported-in to the service provider, then launching the HLR Query first is likely to result in returning a profile and eliminating the need for a NP Query. However, this is predicated on the assumption that a profile in the HLR represents an active subscriber; which, in turn, presumes that a donor network is able to synchronize their HLR with respect to the NP database update. That is, a donor network that ports out a number is required to "de-provision" their HLR at the same time that the NP database is updated. Otherwise, they may have an HLR record for a ported out subscriber.

Given the concern for HLR performance degradation and the desire for avoiding strict HLR and NP database synchronization, *the switch should launch the NP Query first for mobile originated calls.*

However, the switch could offer the option of allowing the service provider to specify for each NPA-NXX whether the MSC should perform the NP or HLR Query first. Should this option be implemented, the default should be to perform the NP Query first unless specified otherwise by the service provider. The determination of when to override the default and perform the HLR Query first is actually dependent on the call volume to the ported subscribers, not the actual number of ported subscribers. It is incumbent on the service provider to perform the necessary traffic studies to determine when it is optimal to change the setting.

Assuming the MSC performs the NP query prior to any HLR query, the NP query will result in one of the following conditions:

- *No LRN is returned.* The number has not ported and is currently served by the switch holding the NPA-NXX of the DN; therefore, the MSC should continue processing the call and perform an HLR Query. If the HLR Query indicates that no active profile is present, the MSC should provide appropriate intercept treatment, otherwise complete the call through normal mobile call completion processes.
- *LRN matching that of the MSC launching the NP Query is returned.* The number is currently served by that MSC. An HLR query should be performed. If the HLR query indicates that no active profile is present, the MSC should provide appropriate intercept treatment, otherwise complete the call through normal mobile call completion processes.
- *LRN of some other switch is returned.* The MSC should formulate an ISUP message containing a Generic Address Parameter, set the Forward Call Indicator as "dip performed," and route the call.

If the switch implements the option of allowing the service provider to indicate which query is launched first and the setting indicates that the HLR Query should be done first for that NPA-NXX, then the MSC should launch the HLR Query with results of one of the following conditions:

- *An active subscriber profile exists.* The number is assigned to an existing subscriber. The MSC should process the call according to existing mobility procedures per the return results. An NP Query is not necessary.
- *No Active Subscriber Profile Exists.* The number has ported out, the number is not assigned, or the ported-in number is being aged prior to being returned to the donor service provider. The MSC should launch the NP Query. The result will indicate one of the following conditions:
 - *No LRN is returned.* The number has not ported and is currently served by the MSC. Intercept treatment should be provided.
 - *The LRN of the MSC that launched the NP Query is returned.* The number is currently served by that MSC. However, no HLR record was present; therefore, the number is being aged. The MSC should provide appropriate intercept treatment.
 - *The LRN of some other switch is returned.* The subscriber has ported out and is being served by another service provider. The MSC should formulate an ISUP message with the appropriate parameters (i.e. Generic Address Parameter, Forward Call Indicator).

3.1.6.4 Error Handling

Number portability allows new error conditions to occur and thus must be detected. These relate to the processing of incoming ISUP. For instances in which the ISUP message does not contain the GAP parameter, normal ISUP error handling procedures apply. However, several new error combinations must be considered when the GAP parameter is present.

It is possible that errors in provisioning the NPAC could result in an incorrect association of a subscriber's number and a service provider's LRN. This can occur by either correctly entering

the subscriber's number and incorrectly entering the LRN, or vice versa. In either case, the switch originating the NP Query will receive an LRN that should be used to route the call and cannot detect the error.

Assuming the LRN is a value that can be routed, the terminating switch will examine the LRN and assuming it supports the ISUP enhancements, it will examine the GAP parameter. The new type of error condition that must be detected is when the central office code in the GAP parameter has not been "opened" on the terminating switch. In such situations, the serving switch should clear the call using Cause Code # 26, "LNP routing error".

It is not sufficient for the MSC to simply examine the GAP parameter and then launch an HLR Query to determine whether the subscriber exists or not. In the error condition, the subscriber, by definition, will never exist in the HLR. This needs to be differentiated between the normal case in which the code has been opened, but the subscriber information is not present in the HLR due to providing aging and intercept treatment.

Thus, the MSC must be able to recognize which central office codes have been opened.

3.1.7 Global Title Translation

GTTs are used in the WNP environment, based on the DN, the MIN, and the IMSI. The following text describes some of the GTTs available. The need for new translation type assignment will be identified as part of the NP standards process. This section defines and categorizes the possible GTT uses in the WNP environment. It is not a specific request for new translation type assignments.

3.1.7.1 LRN Global Title Translation

The LRN GTT is the 6-digit GTT (based on portable NPA-NXX) used to direct WNP query messages to the NP DB to obtain the LRN routing information. The LRN GTTs SCCP Called Party Address (CdPA) contain the first six digits of the portable dialed DN.

Translation Type 11 is currently assigned by T1S1 for LRN GTTs. This translation type is to be used across all query formats (i.e., AIN, IN/1, and IS-41). It is up to the NP DBs TCAP processing to interpret the message correctly.

3.1.7.2 Mobile Station Identifier Global Title Translations

MSID GTT messages, if identified, contain the MSID in SCCP CdPA. These GTTs are used to perform GTT for MSID-based inter-network capabilities and services. Since the MSID is not portable, number portability has no impact on the GTTs that translate on MSID.

3.1.7.3 Mobile Directory Number Global Title Translations

Most GTTs in the past have been based on the MIN. However, with the separation of the MSID and MDN, GTT based on MDN is needed to achieve this past functionality. MDN GTT messages contain the MDN in the CdPA. They are used to perform GTT for MDN-based network capabilities and services. There are significant GTT impacts for MDN based

capabilities that only provide the first six digits of the MDN in the CdPA. The impacts are because the previously used six digit numbering schemes no longer provide sufficient addressing granularity in a number portability environment. When a customer ports to a new service provider, a 10-digit GTT entry is needed in each inter-network service GTT database so that queries are delivered to the appropriate network. In these cases, inter-network service GTT databases will have 10-digit GTT entries and 6-digit default entries. The 10-digit GTT entries of the GTT database are the numbers ported to a new service provider in the served portability area that require inter-network service. When a 10-digit GTT entry for a ported subscriber is not found, the 6-digit default GTT is interrogated to obtain the necessary routing information.

Two solutions are available to address service GTTs. The first modifies all query-originating applications to provide ten digits in the CdPA for GTT. This solution is not preferred by the wireline industry due to the update expense of the originating offices. Ten digits should be provided in the SCCP CdPA for any new capability.

The second solution, called TCAP-GTT, is used when only six digits are available in the CdPA. TCAP-GTT performs GTT by obtaining the MDN (or dialed digits) from the TCAP portion of the message. Note that this case requires a ten-digit MDN (or dialed digits) in the TCAP portion of the message. In most cases, this information is available. Normal SCCP error procedures should be invoked if the GTT fails, even if the failure occurred during TCAP interrogation.

3.1.7.4 Wireline Service Global Title Translations

Wireline Service GTTs for services sent to or received from wireline networks may be needed in wireless networks. These GTTs require 10-digit translation in order to determine the appropriate destination where the query is to be sent. Impacts to these GTT databases are the same as described in the above section.

3.1.8 *Home Location Register and Authentication Center*

The Home Location Register (HLR) is a standard function of wireless signaling and mobility management. The WNP solution presumes the HLR serves the same function. The HLR holds the subscriber profile which should be capable of separating and mapping the MDN to the MSID.

The Authentication Center is also a standard function in wireless telecommunications. The separation of the MSID and the MDN may impact the AC and its associated authentication formulas; the signaling between the HLR and the AC, however, is not likely to be impacted by WNP.

3.1.8.1 Directory Number to HLR Mapping

When a Location Request message is routed to the home network, the network must route the Location Request message to the subscriber's HLR. Some networks have stand-alone HLRs separate from the MSC; some networks have multiple HLRs.

HLR subscriber profiles are typically arranged and indexed by MSID. However, the home network may only have the subscriber's MDN to use for routing the Location Request message to the HLR serving the subscriber. Service providers that employ stand-alone HLRs or have multiple HLRs supported an MSC need to ensure that the Location Request message is routed to the correct HLR for the subscriber. This scenario is further complicated if a WSP deploys an MSC gateway architecture.

Service providers can implement a Location Request routing method that is effective in their internal network.

3.1.9 Abnormal Procedures

A number of situations exists where a call requires WNP processing but a failure prevents the switch from receiving an LRN for routing the call. Such instances include

- signaling link failure,
- NP DB outage or overload,
- WNP query timer expire, or
- incorrect STP translation.

Regardless of the cause, the MSC should route the call as if the dialed directory number were not in an open portable block. Specifically, the FCI bit in the IAM message should not be set and the CdPN parameter should contain the dialed DN.

This procedure of routing the call as if it were not ported is called "default routing" and ensures that additional attempts will be made to complete the call. With default routing, a chance exists that the call might route to the donor network. The donor network should attempt to perform the query and route the call to the correct service provider.

3.2 Call Flows

The call flows in this section are included to illustrate the inter-workings of the above network architecture. They are based on IS-41 but are not meant to preclude GSM based protocols. The messages are meant to convey the required function and are not necessarily the actual messages defined in the protocol. Furthermore, the call flows do not represent all the information that is conveyed in each instance, only that pertinent to number portability. The call flows are based on normal procedures and do not include error conditions.

3.2.1 Registration and Authentication

Because of the separation of the MDN and MSID, registration procedures are slightly modified. When a mobile station registers, the serving switch signals the MSID to the HLR as currently accomplished. Upon receiving the MSID, the HLR determines whether the indicated subscriber has the same MDN value as the MIN. If not, the HLR returns the associated MDN in the response message. Current IS-41 standard agreements recommend also returning the MDN when the MDN is equal to the MIN. This value should be used by the Serving MSC/VLR in

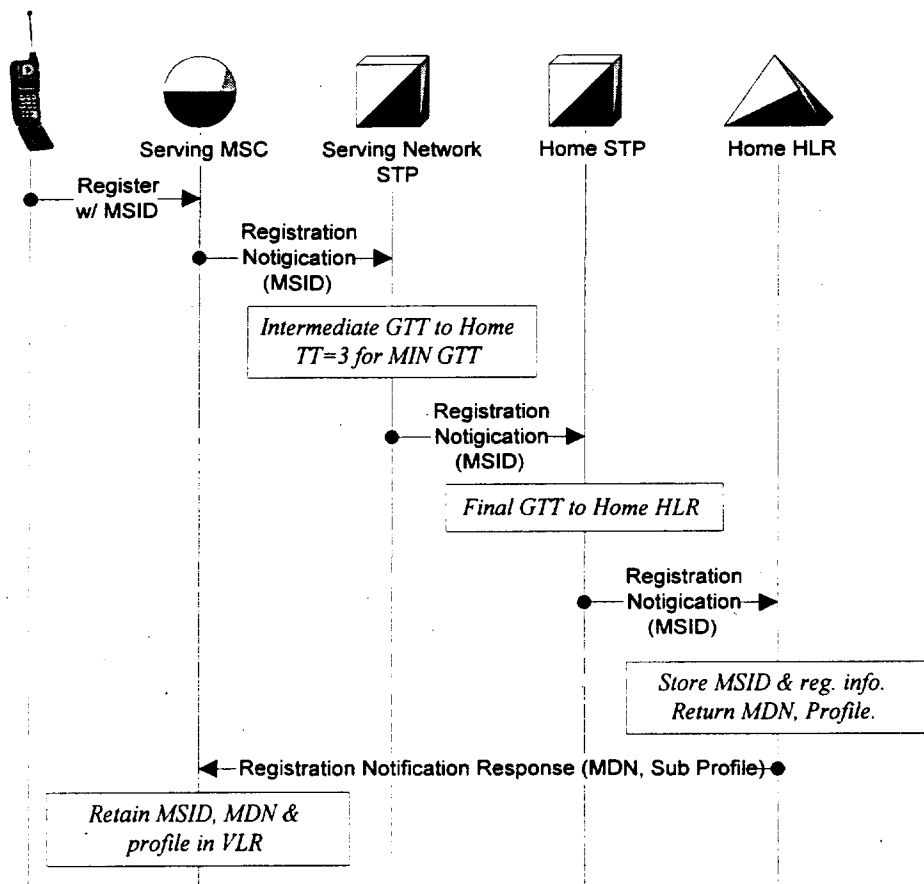
subsequent call processing for that mobile. If there are multiple MDNs associated with the MSID, then a single value should be indicated as the default.

If the IS-41 registration procedures are based on the IMSI, then the MDN is always returned. No impact to the GSM based procedures are identified in this document at the present time.

Authentication procedures are not impacted and still operate using the MSID.

The following call flow illustrates the registration process.

Figure 3-2 Mobile Registration



Call Flow Details:

- (a) The mobile station registers via the air interface with the serving network communicating its MSID.

- (b) The Serving MSC sends a RegistrationNotification with the MSID into the serving network's SS7 network.
- (c) The serving network's STP performs an Intermediate GTT (I-GTT) on the data. TT=3 indicates that the translation should be on the MSID(MIN). This translation is MIN to Home Network. (TT=9 can be used for IMSI to Home Network translations.)
- (d) The Home Network STP performs a Final GTT (F-GTT) to ascertain the HLR which holds the subscriber's profile. This translation is MIN to HLR.
- (e) The HLR, using the MIN to index the profile, returns the MDN and subscriber profile information.
- (f) The Serving MSC, upon receipt of this information, stores the MDN, MIN, and subscriber profile information in its VLR.

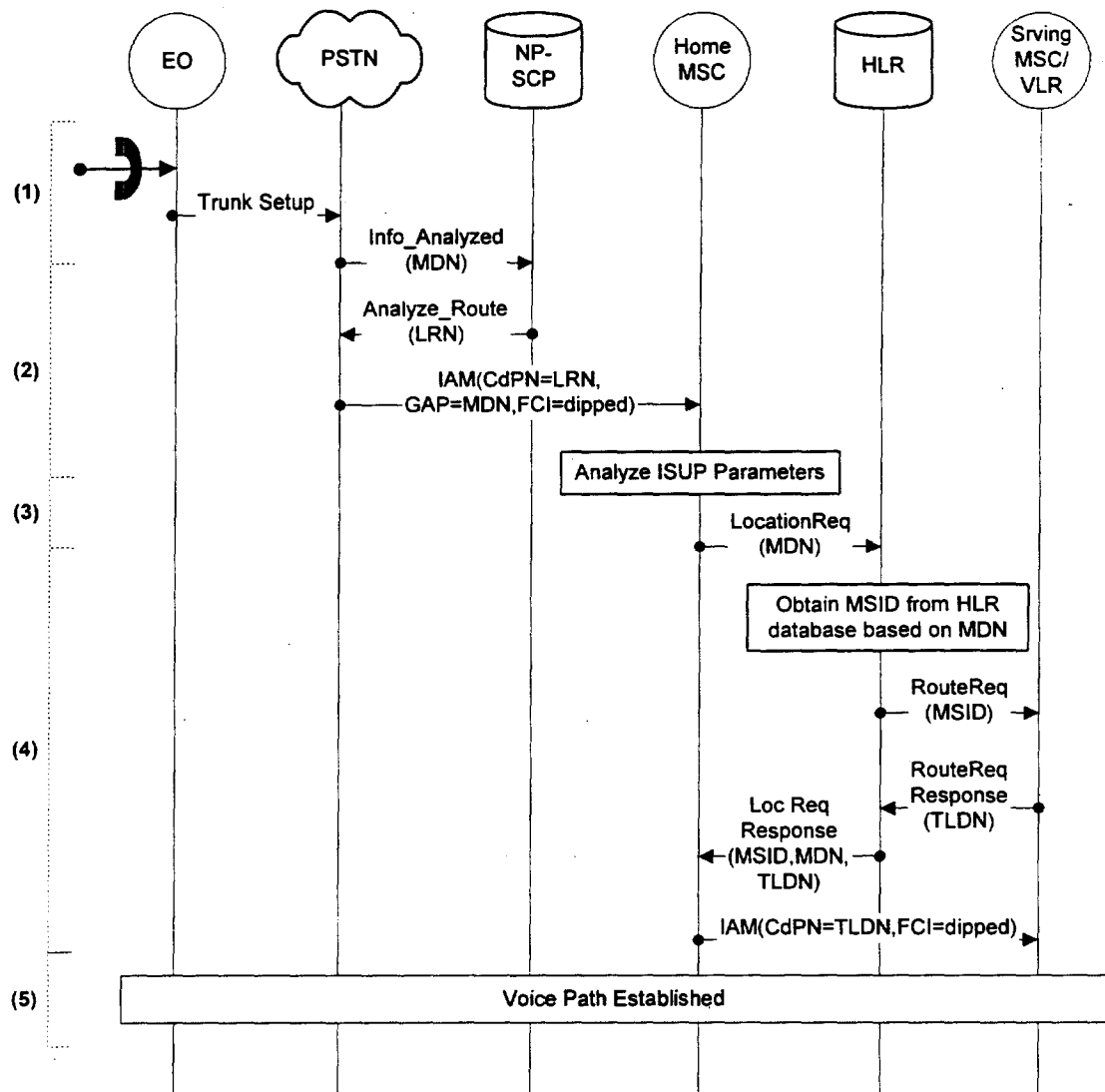
3.2.2 Call Routing To a Ported Directory Number

Wireless call routing can be divided into three scenarios: Land-to-Mobile, Mobile-to-Land, and Mobile-to-Mobile.

3.2.2.1 The Landline-to-Mobile Call

Figure 3-3 illustrates a landline call to a ported mobile subscriber. Text follows the figure for an explanation of each step.

Figure 3-3 Landline to Mobile Call Flow



Associated Call Flow Description:

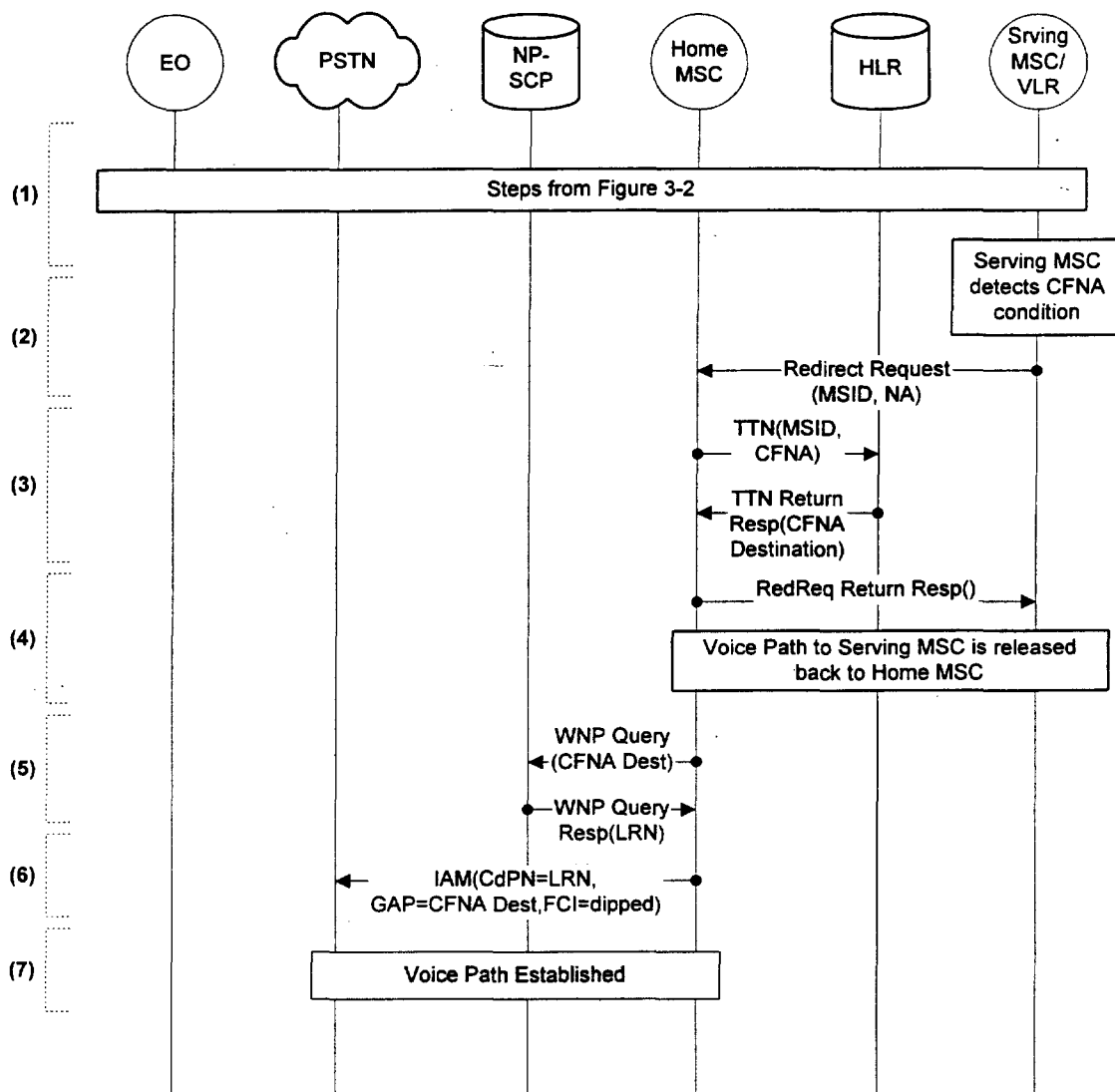
- (1) A landline phone originates a call.
- (2) A landline switch queries the NP DB, obtains the LRN for the ported MDN, and uses the LRN to route to the Home MSC.
- (3) Upon receipt of the IAM message, the MSC performs the following analysis:
 - (a) It confirms that the CdPN belongs to its own network.
 - (b) It checks the FCI "m" bit for the NP DB dip indication. If the "m" bit is not set, then the call flow skips to step 4. If the "m" bit is set, but no GAP is included, the call flow skips to step 4. If the "m" bit is set and the GAP is included, the MSC uses the value in the GAP parameter as the CdPN.

- (4) The MSC now attempts to locate and deliver the call to the mobile using existing call delivery procedures with the following highlights:
- The Location Request Return Result should include the MSID.
 - The final trunk setup IAM message should ensure that a query is not necessary on a TLDN by setting the FCI query indicator.
 - If the MSC cannot distinguish between TLDN digits and Call Forwarding digits, the MSC, in attempting to route out the call, may activate the WNP trigger and unnecessarily query the NP DB. This document recommends that IS-41 provide the means to indicate type of digits so that, at a minimum, the MSC can know to set FCI bit as appropriate so that an unnecessary dip does not occur in the PSTN during final trunk setup.
- (5) The mobile station answers the call and the voice path is established.

3.2.2.2 The Landline-to-Mobile Call with Call Forwarding interaction

Figure 3-4 illustrates a landline call to a ported mobile subscriber. This call flow, however, depicts the subsequent leg of the call when the call is forwarded, for example, to a voice mail system. Specifically, this call flow illustrates only one example of redirection, Call Forwarding No Answer (CFNA). Text follows the figure for an explanation of each step.

Figure 3-4 Landline to Mobile with CFNA Interaction



Associated Call Flow Description:

- (1) A landline phone originates a call. The processing to establish the voice path to the serving MSC is identical to the call flow in Figure 3-2 and is, therefore, not repeated here.
- (2) The Serving MSC detects a No Answer (NA) condition and send a Redirection Request message to the Home MSC indicating the reason (NA) for the redirection request.
- (3) The Home MSC sends a Transfer-to-Number Invoke to the subscriber's HLR and forwards the NA indicator. The HLR determines if the subscriber has the CFNA feature

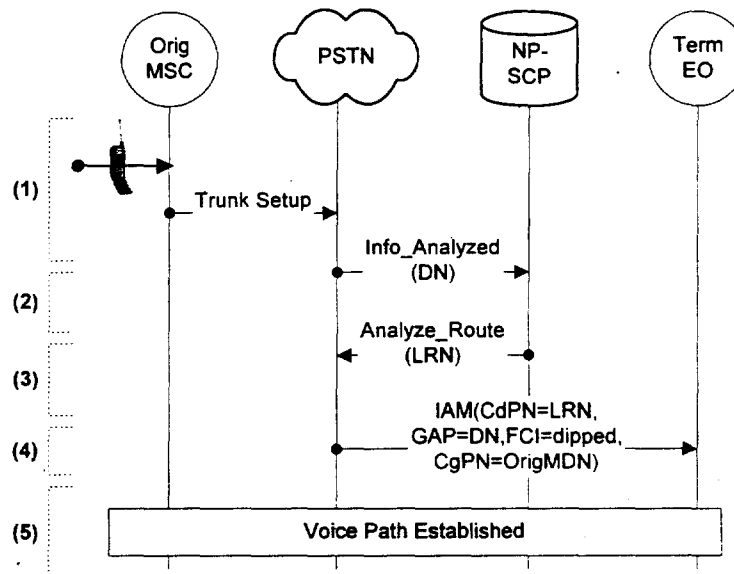
authorized and active. If the CFNA feature is authorized and active the HLR sends a Transfer-to-Number return result message back to the Home MSC with the CFNA destination digits included.

- (4) The Home MSC sends a Redirection Request Return Result message to the Serving MSC, and the voice connection between the Home MSC and the S-MSC is released.
- (5) The CFNA destination digits are analyzed in the Home MSC to determine if a query should be made on the destination digits. The query returns the LRN.
- (6) The Home MSC formulates the IAM message with the CdPN equal to the LRN, the GAP equal to the CFNA Destination Digits, and the FCI indicator to dipped.
- (7) The call is completed with the new destination.

3.2.2.3 The Mobile-to-Land Call

Figure 3-5 illustrates a mobile to landline call in which the MSC is not the designated querying switch, i.e. a PSTN switch will perform the query. Figure 3-6 also illustrates a mobile to landline call, but in this case the MSC is the designated querying switch.

Figure 3-5 Mobile to Landline - PSTN Performs Query

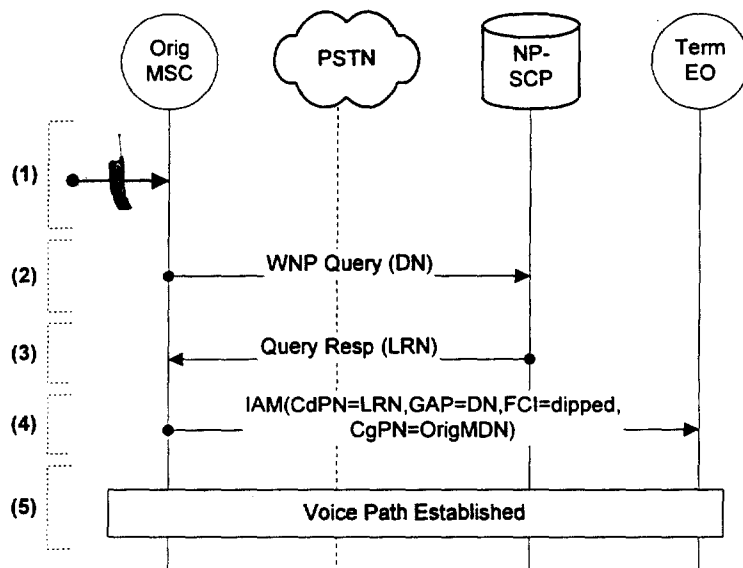


Associated Call Flow Description:

- (1) A mobile places a call, and the Originating MSC passes the call to the PSTN.
- (2) The PSTN detects DN is within a portable block and launches a query to the NP DB with the landline DN.
- (3) The NP DB returns the LRN for the DN.

- (4) The PSTN formulates and sends the IAM message with the CdPN equal to the LRN, the GAP equal to the DN and the FCI "m" bit set as queried to the terminating end office.
- (5) The Terminating EO will complete the call to the loop to the assigned to the DN. The call is then connected.

Figure 3-6 Mobile to Landline - MSC Performs Query



Associated Call Flow Description:

- (1) A mobile places a call
- (2) The Originating MSC detects DN is within a portable block and launches a query to the NP DB with the landline DN.
- (3) The NP DB returns the LRN for the DN.
- (4) The MSC formulates and sends the IAM message with the CdPN equal to the LRN, the GAP equal to the DN and the FCI "m" bit set as queried to the terminating end office.
- (5) The Terminating EO will complete the call to the called DN.

3.2.2.4 The Mobile-to-Mobile Call

Figure 3-7 illustrates a mobile to mobile call in which the MSC is not the designated querying switch, i.e. a PSTN switch will perform the query. Figure 3-8 also illustrates a mobile to mobile call, but in this case the MSC is the designated querying switch. In fact, these figures illustrate that a concatenation of the previous figures (mobile originated and mobile terminated) produce expected results. This is an expected result because the originating and terminating MSCs are unaware of one another.

Therefore, no text is included beyond the figures for the sake of readability. Readers can infer the appropriate descriptions based on the previous call flows.

Figure 3-7 Mobile to Mobile - PSTN Performs Query

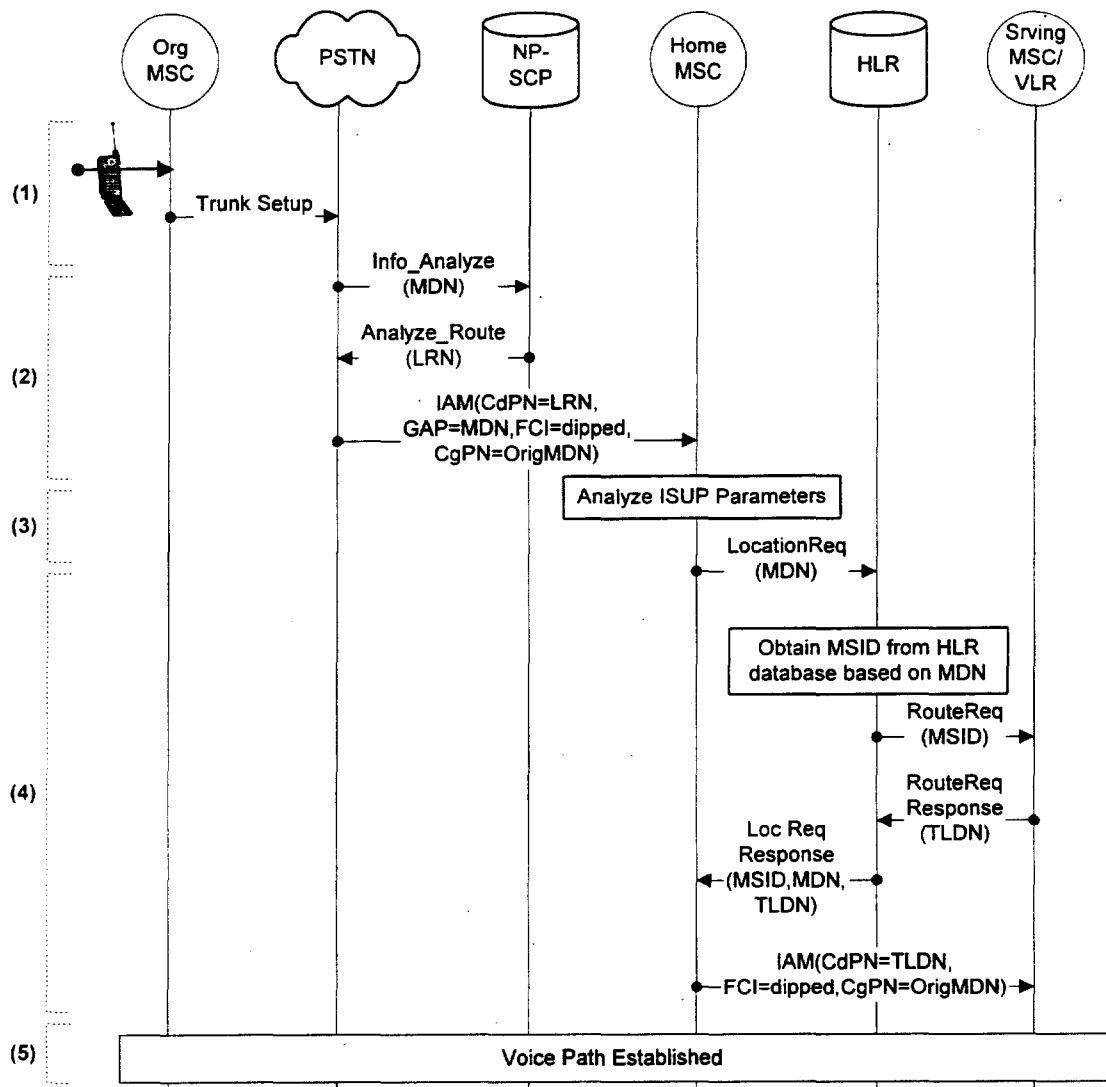
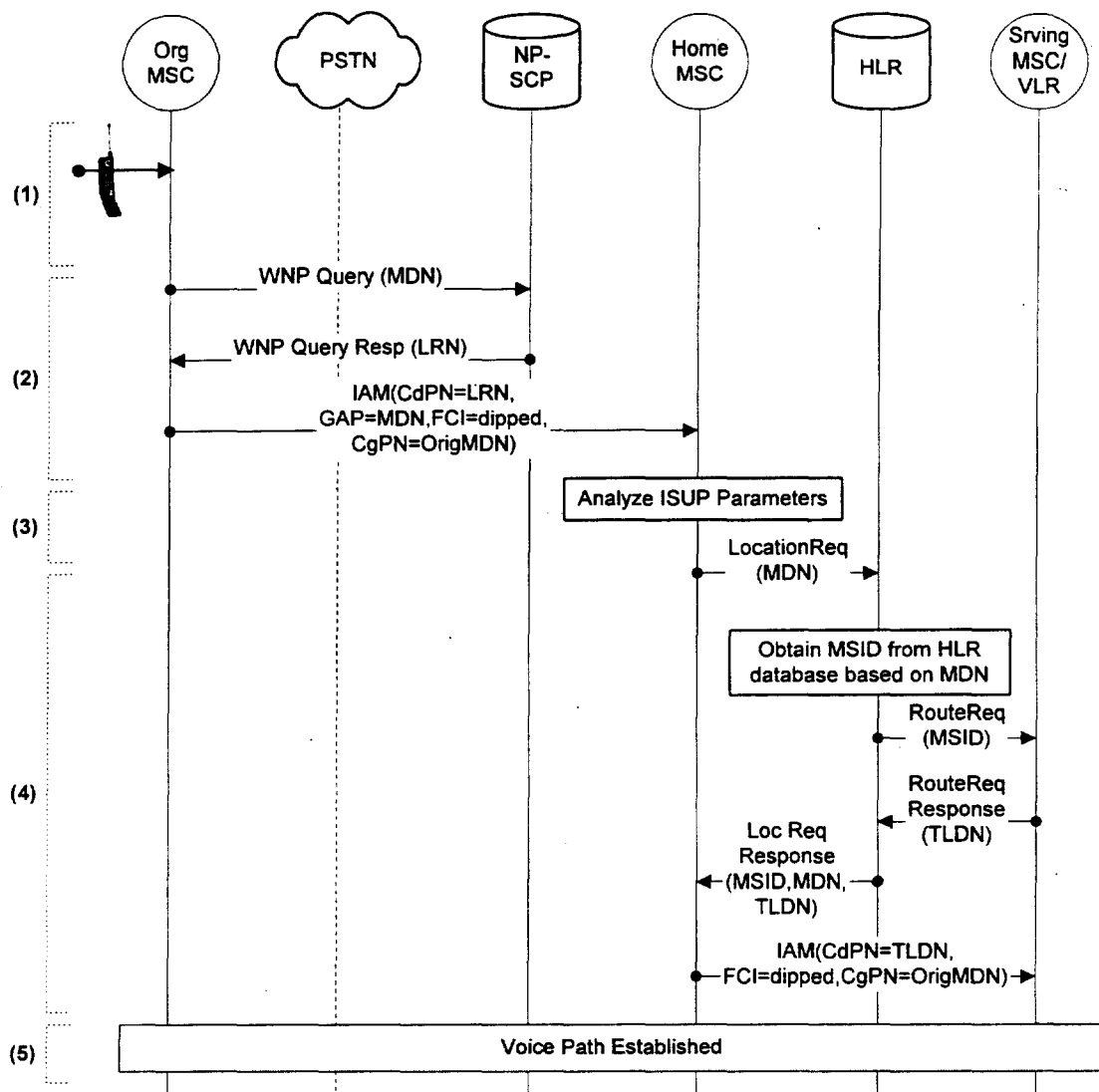


Figure 3-8 Mobile to Mobile - MSC Performs Query



3.3 Feature Interactions

This section describes the effect of WNP on the current base of wireless services.

3.3.1 Operator Services

An MSC can connect to an operator tandem switch in one of the three following ways:

- via a Type 1 connection to a local telephone company central office switch that interconnects with the operator tandem;
- via a Type 2D connection directly to the operator tandem; or
- via a Type 2A connection to an access tandem that interconnects with an inter-exchange carrier operator tandem using Feature Group D (FGD) signaling.

A mobile station dialing any of the following should route the call directly to the operator tandem where, if necessary, it will perform the query:

- 0-
- 00-
- 10xxx0-
- 101xxxx-0-
- 0-NPA-NXX-XXXX
- 10XXX-0-NPA-NXX-XXXX
- 101XXXX-0-NPA-NXX-XXXX

Existing ANI information transfer and AMA recording at the operator tandem will be sufficient to support WNP. However, the MSC must be modified to forward the MDN and not the MSID as the ANI digits.

3.3.2 Roamer Access Port

The Roamer Access Port service is one of several means of supporting call termination to roamers. Another feature of the Roamer Access Port is to allow the caller to directly be connected to the serving system, eliminating the call segment from the home system to the serving system.

Under the Roamer Access Port services today, the caller dials a roamer access port number to reach the visited system and enters a roamer's MIN (which is the same as the MDN prior to number portability). When the switch is WNP capable, then it must interpret the entered digits as the roamer's MDN. It must then map this to the MSID value (either MIN or IMSI) for paging the appropriate mobile station.

3.3.3 Emergency Services

An MSC can connect to Emergency Services Providers (ESPs) in many ways. The current arrangements typically do not automatically forward the mobile station callback number to the ESP. For such arrangements, the ESP attendant must verbally request the callback number, if desired. FCC rules regarding emergency service calls from wireless systems dictate that by April 1, 1998, an MSC must be capable of automatically forwarding the correct mobile station callback number along with information identifying the cell site of call origin.

In any proposed configuration, the MDN must be provided to the ESP for callback purposes. The impact on the MSC with the WNP solution is such that the MSC must be modified to forward the MDN and not the MSID.

To meet the proposed April 1, 1998, FCC requirements, both the MF-FGD signaling and the SS7 ISUP signaling arrangements may, in fact, be utilized. Therefore, the MSC must forward the MDN and not the MSID as the FGD ANI digits and must forward the MDN in the CgPN parameter of the SS7 ISUP IAM message. This requirement applies to both home mobile stations and roaming mobile stations. Consequently, the MDN must be retrieved from the home system for any registered roaming mobile stations.

The impact of WNP with regard to Emergency Callback whether the call back is over a roamer access port or otherwise requires further study.

3.3.4 Short Message Service

Today, the recipient of a short message is identified by an MDN. The originating network uses the dialed MDN to route the short message to the Called Party Home system. The dialed MDN is the same as the MIN or the first 6 digits of the dialed MDN are the same as the first 6 digits of the MIN if the MDN and MIN are separated. Typically, the first six digits of today's dialed MDN or MIN provide sufficient routing information for the short message to be delivered to the Called Party Home system.

The wireless industry has decided to separate the MSID and the MDN to support WNP. As a result, Short Message Service (SMS) delivery is impacted. SMS will not operate properly as it is currently defined if the destination mobile station has ported its MDN. When the mobile station ports to another service provider, it is assigned a new MSID. The new MSID, particularly the first six digits, will identify the new service provider. However, when a short message is initiated to the ported mobile station, the Calling Party will only provide the MDN to the network (in both IS41 and GSM networks). Since the destination MS has ported, the originating Short Message Entity (SME) or the SS7 network must analyze all the digits of the MDN to derive the necessary routing information to deliver the short message to the destination Home system of the ported mobile station.

Five alternatives were originally proposed to address the SMS routing problem in the WNP environment. The five alternative were:

- (a) SMS Forward to Service Home MC

- (b) Message Center Query, LRN response to Originating MC
- (c) MSC Query - LRN response to Originating MSC
- (d) MDN-to-MSID translation at the NP SCP (NP DB)
- (e) 10-digit GTT at the NP SCP (NP DB)

The recommended solution for WNP SMS is a modification to alternative five and is discussed in the following sections.

The recommended solution for WNP SMS also meets the following criteria as required by the previous CTIA report:

- (a) Routing to the Called Party's (Destination) Home MC

If the short message need not go through the Calling Party's Home MC, the short message is sent to the Called Party's Home MC directly from the originator's serving MSC. The case where a short message is sent from the Calling Party's Home MC to the Called Party's Home MC is also covered under this scenario.

- (b) Routing through the Calling Party's Home MC

If the SMS Origination Restriction of the originator indicates that the short message must be routed through the Calling Party's Home MC, the short message should be sent to the Calling Party's Home MC first.

- (c) International Routing

Each alternative must support the capability to send a short message across International boundaries.

The delivery of SMS messages to a mobile subscriber's Message Center (MC) is impacted by Number Portability (NP) since the message delivery to the destination network is based on the destination subscriber's portable directory number (DN)⁴². The following sections recommend procedures for handling these routing needs with consideration given to:

- Existing translation type assignments for SMS,
- Minimal operational and administration impacts beyond those planned for number portability,
- Network reliability,
- National and international routing needs.

⁴² In this contribution, DN is synonymous with MSISDN, MDN & PSISDN.

3.3.4.1 Mobile Originated SMS

The wireless industry has identified three fundamental routing methodologies for Mobile Originated SMS. The methodologies are called here

- Option A: Calling Party's Home MC to Destination Mobile,
- Option B: Originating MSC to Called Party's Home MC
- Option C: Calling Party's Home MC to Called Party's Home MC.

The recommendations herein support all three of these methodologies.

Option A, Calling Party's Home MC to Destination Mobile, provides SMS message delivery from the Calling Party's Home MC to the destination mobile as shown in Figure 0-1.

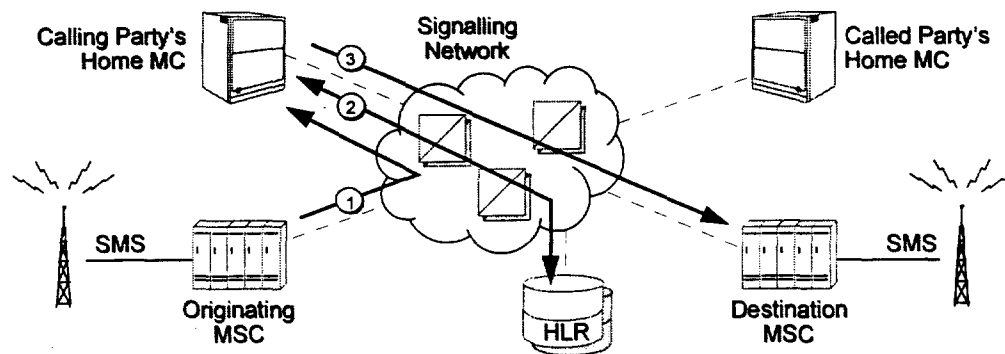


Figure 0-1. Calling Party's MC to Destination Mobile (Option A)

Option B, Originating MSC to Called Party's Home MC, provides SMS message delivery from the originating MSC to the Called Party's Home MC as shown in Figure 0-2.

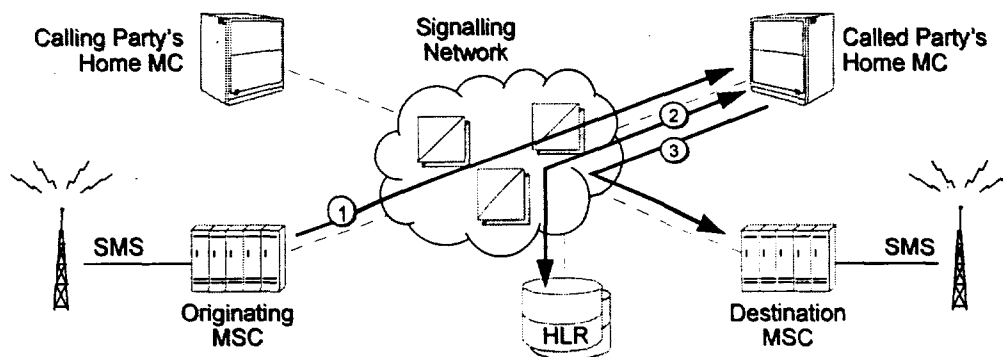


Figure 0-2. Originating MSC to Called Party's Home MC (Option B)

Option C, Calling Party's Home MC to Called Party's Home MC, provides SMS message delivery first to the Calling Party's Home MC. The Calling Party's Home MC then routes the desired message to the Called Party's Home MC. Please see Figure 0-3.

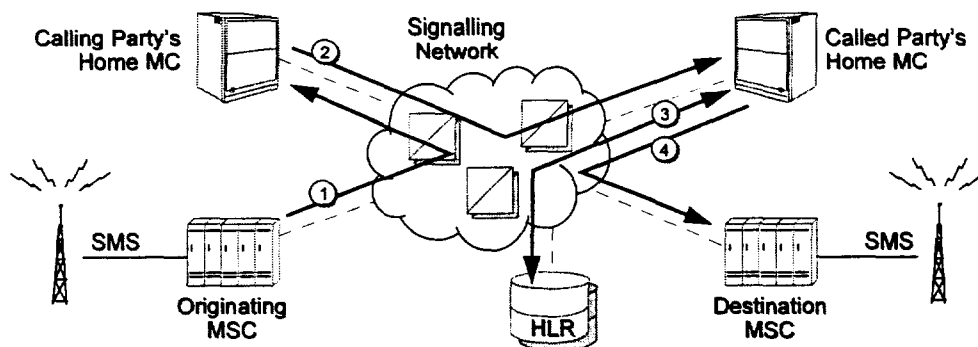


Figure 0-3. Calling Party's Home MC to Called Party's Home MC (Option C)

Options A, B, and C are possible SMS implementations in both IS-41 and GSM networks. They are all supported by the procedures herein. Option C is preferred since it provides the most flexibility in subscriber capabilities.

3.3.4.2 Alternative Path Mobile Messages

The recommendations herein may also apply (as appropriate to the impacts of portability on said method) to short message origination or termination where the short message traverses an alternative path to the above options (e.g., internet). Once at the MC, the procedures pick up according to the access point. For example, if the SMS is externally delivered first to the Calling Party's Home MC, then the procedures herein pick up at that MC. If the SMS is externally delivered to the Called Party's Home MC, then the procedures pick up from that point of the procedures described herein.

3.3.4.3 MTP versus SCCP Routing

All three options may route messages using

- End-to-end signaling as provided by ANSI SS7-Message Transfer Part (MTP), or
- Routing on global title as provided by ANSI SS7- Signaling Connection Control Part (SCCP).

In a WNP environment, near real time SMS routing updates for porting subscribers will be required. This will prove administratively prohibitive if just MTP routing is used since SS7-SMS message originating entities (e.g., possibly all MSCs and MCs) will need to be updated during the 15 minute update window. The use of SCCP GTT logically fits into the planned (in some cases, existing) NPAC provisioning process for ported subscribers at the NP DB.

3.3.4.4 Delivery to the Calling Party's Home MC

Two translation types are currently defined (though not letter balloted by T1/T1S1) for routing to the Calling Party's Home MC:

- Translation Type 12 - MIN based GTT to the Calling Party's Home MC,
- Translation Type 13 - IMSI based GTT to the Calling Party's Home MC.

These translation types are used for routing to the Calling Party's Home MC based on MIN and IMSI. The use of these translation types is recommended for those configurations that deliver the SMS message to the Calling Party's Home MC and for those configurations without the ability to route on the Calling Party's DN.

Since the MIN (i.e., MSID⁴³) and the IMSI are not portable entities, there are no number portability impacts currently identified for translation types 12 and 13.

For those configurations with the ability to utilize the Calling Party's DN (Cg-DN), the Cg-DN can be used for global title routing to the Calling Party's Home MC:

- Option A: DN used to route to Calling Party's Home MC,
- Option C: DN used to route to Calling Party's Home MC.

The use of the Cg-DN, however, will require the introduction of a new translation type for routing to the Calling Party's Home MC. This same translation type, as discussed below, can also be used for routing to the Called Party's Home MC.

3.3.4.5 Delivery to the Destination Network

Regardless of the protocol (IS-41 or GSM) or the network topology (Options A, B, or C), at some point an inter-network SMS message is routed based on the Called DN. More specifically, the Called DN is used as the global title address (GTA) for SCCP GTT. In all cases, regardless of the protocol, the Called DN is a unique E.164 number. The GTT routing needs using called-DN for each option are summarized below:

- Option A: Use Called DN to route to the destination HLR,
- Option B: Use Called DN to route from the Originating MSC to the Called Party's Home MC,
- Option C: Use Called DN to route from the Calling Party's Home MC to the Called Party's Home MC.

3.3.4.6 Message Flows

The "Signaling Network" entity in the following message flows is defined as the necessary SS7 functions for performing global title translation and for inter-network connectivity. The specific

⁴³ Note that in an NP IS-41 environment, the MIN and MDN are separated. To help identify this separation, the term MSID is used for MIN. The term MDN is unchanged.

global title translation procedure and nodes used for number portability are not shown here for purposes of simplification in identifying SMS message flow. It is assumed in these message flows that a number portability process has occurred within the signaling network thus resulting in the proper message delivery. The impacts of number portability are discussed later in this document.

Below is the message flow for Option A, Calling Party's Home MC to Destination Mobile.

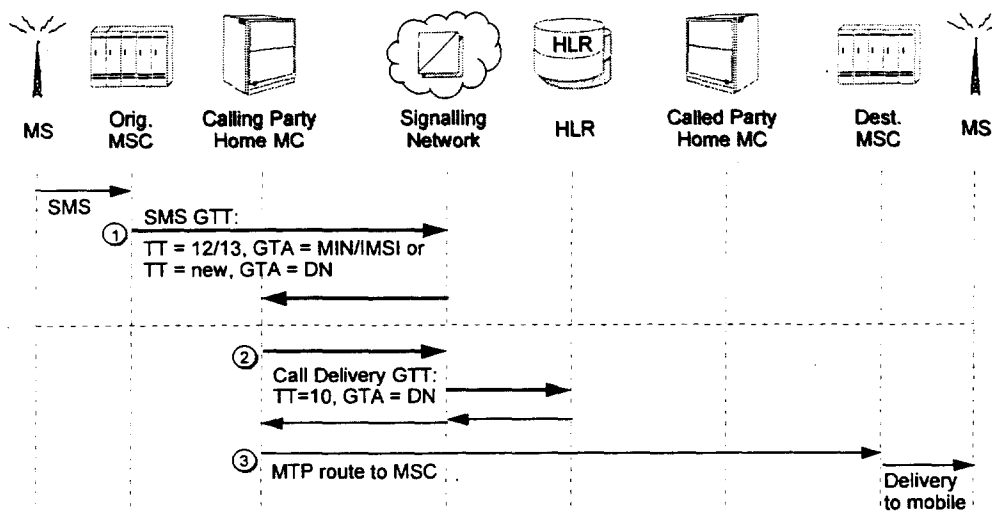


Figure 0-4. Option A Message Flow

- (1) SMS originated.
- (2) Orig. MSC sends SMS to Calling Party's Home MC requesting GTT routing. In absence of the Calling Party's DN, translation types 12 or 13 may be used. If the Calling Party's DN is present, a new "DN-to-MC" translation type is used to route to the Calling Party's Home MC.
- (3) Signalling Network routes using GTT as requested to Calling Party's Home MC.
- (4) Calling Party's Home MC routes to HLR using translation type 10.
- (5) HLR returns Called Party's location to Calling Party's Home MC.
- (6) Calling Party's Home MC MTP routes to Destination MSC.

Below is the message flow for Option B, Originating MSC to Called Party Home MC (a.k.a. direct routing).

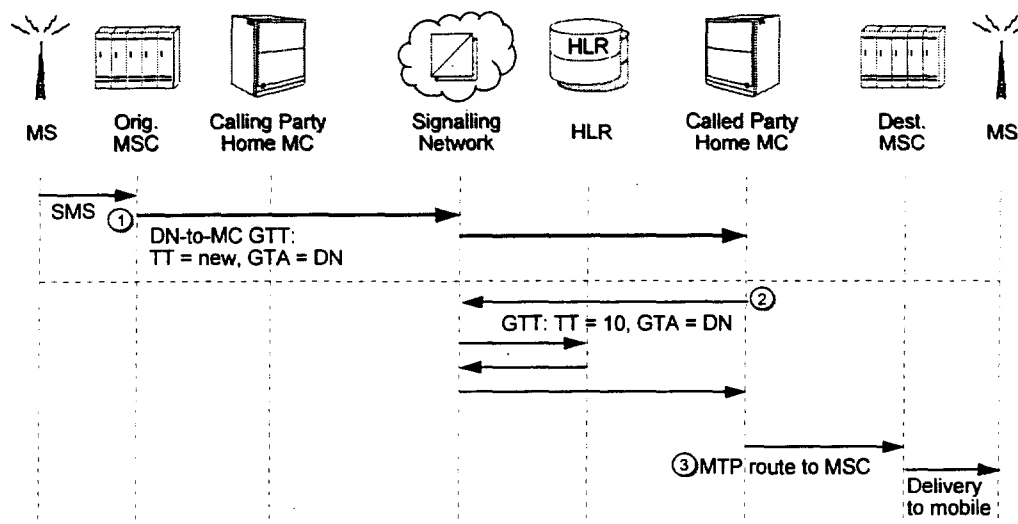


Figure 0-5. Option B Message Flow

- (1) SMS originated.
- (2) Orig MSC sends SMS to Signaling Network requesting GTT using the new “DN-to-MC” translation type.
- (3) Signaling Network, using the new “DN-to-MC” translation type, performs GTT and delivers the SMS to Called Party’s Home MC.
- (4) Called Party’s Home MC routes to HLR using translation type 10.
- (5) HLR returns Called Party’s location to Called Party’s Home MC.
- (6) Called Party’s Home MC MTP routes to Destination MSC.

Below is the message flow for Option C, Calling Party's Home MC to Called Party Home MC (a.k.a. indirect routing).

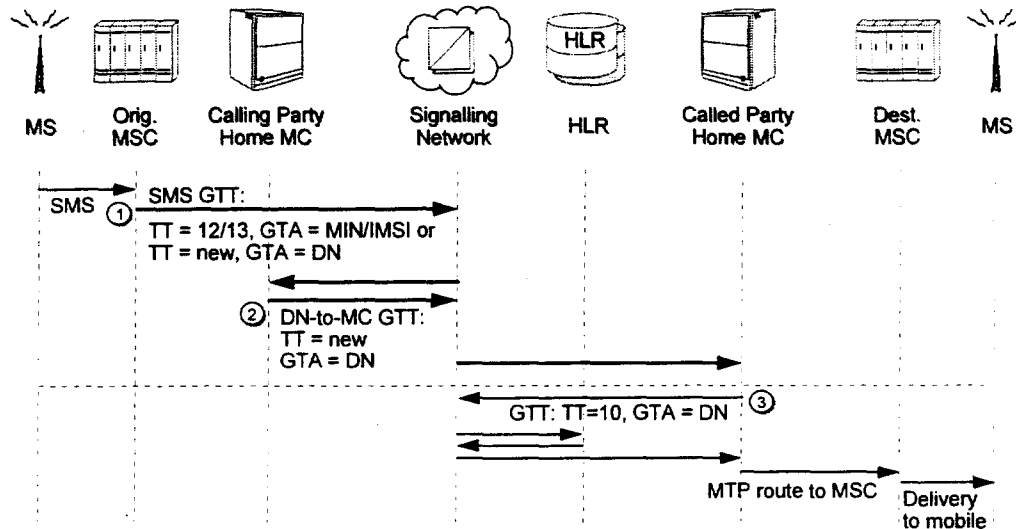


Figure 0-6. Option C Message Flow

- (1) SMS originated.
- (2) Orig. MSC sends SMS to Signalling Network requesting GTT routing. In absence of the Calling Party's DN, translation types 12 or 13 may be used. If the Calling Party's DN is present, the new "DN-to-MC" translation type is used.
- (3) Signalling Network routes to Calling Party's Home MC using GTT as requested.
- (4) Calling Party's Home MC sends SMS to Signalling Network requesting GTT routing using the Called DN with the new "DN-to-MC" translation type.
- (5) Signalling Network, using the new "DN-to-MC" translation type, performs GTT and delivers the SMS to Called Party's Home MC.
- (6) Called Party's Home MC routes to HLR using translation type 10.
- (7) HLR returns Called Party's location to Called Party's Home MC.
- (8) Called Party's Home MC MTP routes to Destination MSC.

3.3.4.7 Comparison of Message Delivery Options

This section compares the three message delivery (i.e., routing) options.

Options A and C both show routing the SMS message from the originating MSC to the Calling Party's Home MC using translation types 12 or 13 (i.e., MIN / IMSI). This method meets the

routing needs for those carriers who only have a MIN or IMSI for routing to the Calling Party's Home MC.

A carrier that is utilizing Options A and C and has the Calling Party's DN available, may use GTT routing based on Cg-DN for routing to the Calling Party's Home MC. This is the same GTT routing table used for locating the Called Party's Home MC as described below.

Options A, B, and C all can use translation type 10 for queries to the HLR. Today, many networks MTP route to the HLR. For GTT routing to the HLR, translation type 10, though specified for PCS call delivery, can be used regardless of the protocol (IS-41 or GSM).

Options B & C both require the need for routing to the Called Party's Home MC based on Cd-DN. Translation type 10 currently routes using the DN to get to the HLR. This conflicts with the needs for routing to the Called Party's Home MC and therefore can't be used. Because of this conflict (i.e., unique routing needs for SMS), the DN-to-MC translation type is needed. This new translation type is useable in both IS-41 and GSM networks since the DNs in both networks are unique and of the same format (i.e., E.164).

3.3.4.8 New DN-to-MC Translation Type

Both GSM and IS-41 networks utilize GTT routing to the MC based on the DN. Since DNs are unique, one new translation type will serve the needs of both of these protocols. The carrying of different application parts does not impact the GTT process. This translation type carries the E.164 formatted DN. The purpose of this translation is to route to an MC associated with the specified DN. The DN carried in these messages identifies either the Calling Party or Called Party, based on the routing needs of the SS7 message originator. This new translation type is subject to the impacts of number portability since both the Calling Party or Called Party can be portable.

There is no translation type currently defined for DN-to-MC routing. Justification is therefore identified for requesting assignment of this new translation type from T1S1 (if this translation type meets the needs of the wireless industry).

3.3.4.9 Signaling Network Impacts

Signaling network GTT procedures for E.164 GTAs can deliver inter-network messages using GTT (with DN and the DN-to-MC translation type) up to the boundaries (defined by GTT databases) of an area of portability using seven-digit GTT. At this point, an eleven-digit GTT procedure against a number portability database is required for proper network termination to the addressed Home MC.

3.3.4.10 Translation Type 10 (PCS Call Delivery)

Translation type 10 carries an E.164 formatted DN for delivery to the indicated subscriber's HLR. Since the DN carried in these messages can identify a portable subscriber, translation type 10 is may be subject to the impacts of number portability whenever it is used for message delivery to a ported subscriber.

For normal call delivery, however, translation type 10 will be impacted since it is used to deliver calls to ported subscribers.

3.3.4.11 DN-to-MC Global Title Address Format

The format of the Global Title Address (GTA) is based on the E.164 numbering plan. For World Zone 1 (WZ1)⁴⁴, the format is shown in Figure 0-7.

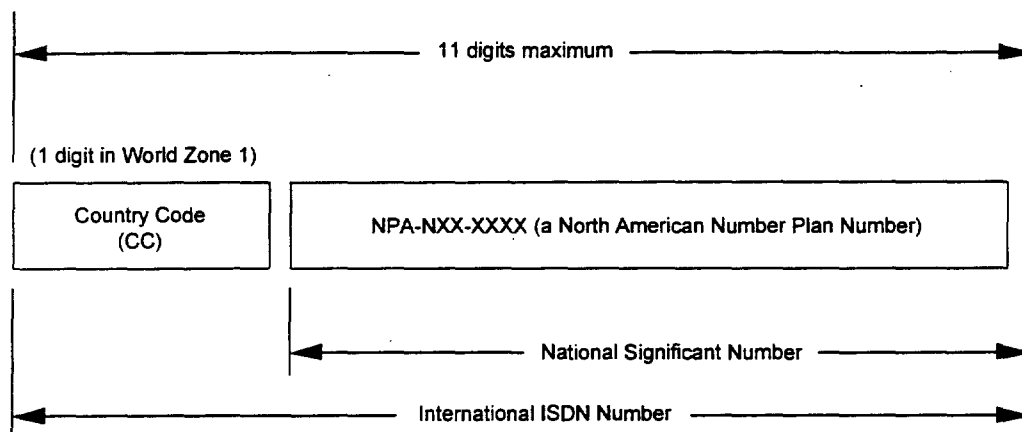


Figure 0-7. E.164 Number Format Inside WZ1

- Within WZ1, the maximum length of the E.164 GTA is 11 digits.
- The Global Title indicator is 0010.
- The digits of the GTA are Binary Coded Decimal in 1/2 octet per digit.
- For Numbers outside WZ1, the format of the E.164 GTA is shown in Figure 0-8.

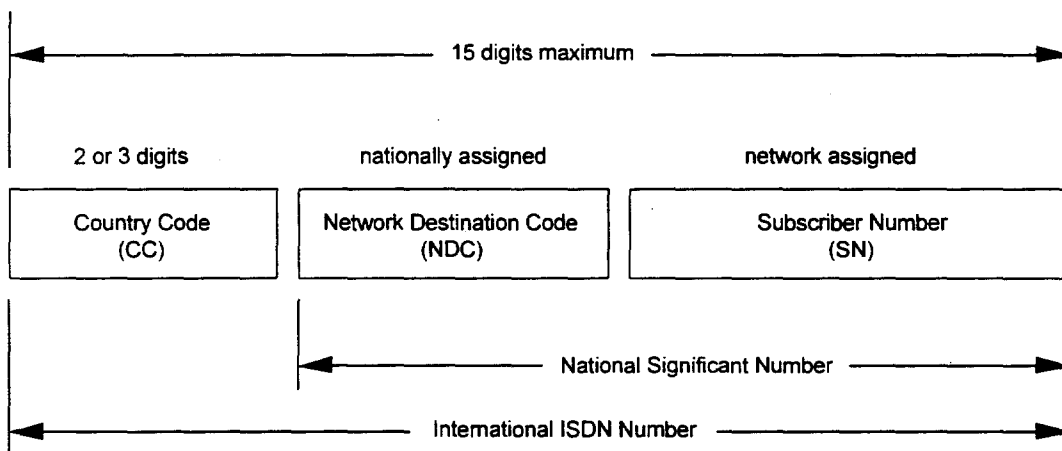


Figure 0-8. E.164 Format Outside WZ1

⁴⁴ World Zone 1 is more formally known as Integrated Numbering Plan 1.

- The maximum length of the E.164 GTA information is the maximum allowed by the numbering plan (up to 15 digits).
- The country code (CC) is 2-3 digits.
- The National Destination Code (NDC) length depends on the country in question.
- The SN is the subscriber number.
- The Global Title Indicator is 0010.
- The digits of the GTA are coded in Binary Coded Decimal of 1/2 octet per digit.

3.3.4.12 SMS GTT Procedures

When the CC indicates that the country is in WZ1 (i.e., CC=1), the E.164 GTA information contains 11 digits.

SMS GTT procedures, upon encountering CC=1, perform six-digit GTT on digits two through seven (i.e., the NPA-NXX) to route to the boundaries (defined by GTT databases) of an area of portability.

Within the area of portability (or at a NP DB serving multiple portability areas), a ten-digit GTT using digits two through eleven (i.e., the NPA-NXX-XXXX) is required for delivery to the appropriate network. If an entry is not found in the SMS ten-digit GTT database, a default GTT will be required. The default GTT is performed typically on the NPA-NXX portion of the GTA.

The output of the final GTT is the DPC and SSN of the MC to which the message is being routed.

As stated earlier, the GTA contains either the Calling Party's DN or the Called Party's DN, the selection of which is done according to the needs of the query originator (i.e., routing to the Calling Party's Home MC or the Called Party's Home MC).

When the CC indicates a country outside WZ1, the E.164 GTA information contains the maximum allowed by the numbering plan. Global Title Translation on the first three (3) digits is required to route to the destination country. The message may need to traverse an inter-national gateway to convert between national and inter-national protocols.

3.3.4.13 Number Portability GTT Signaling Network Performance Impacts

GTT processing performance (i.e., the amount of time required to do a GTT) is not necessarily an issue for SMS;- it is, however, a major issue for translation type 10 and other time sensitive network capabilities. Service providers should review this area with their vendors to ensure GTT processing performance meets the needs of their networks.

3.3.4.14 NP GTT Database Provisioning for SMS

Wireless networks are expected to interface to the NPAC so that they obtain the necessary information to deliver calls to ported subscribers and, in the future, pooled number management. Given that an NPAC interface is required for ported subscribers, it make good sense to utilize it for SMS.

Adding new GTT provisioning requirements (i.e., reservation of service space for point code and subsystem) to this interface should be minimal. The GSM side of the industry has already requested NPAC space in support of two applications to include the NP routing needs for SMS and to support the need for another application if so needed. The use of the recommendations herein would use these two reservations for the new DN-to-MC translation type and for translation type 10.

Not using NPAC is undesirable. In the absence of NPAC, each service provider would be required to manually update records as NPAC added and removed records from the NP databases. Doing such is perceived as administratively impossible due to the anticipated volume of updates.

As stated earlier, the E.164 format of the DN is an eleven digit format where the last ten digits are a North American Numbering Plan (NANP) number. Only the ten-digit NANP needs to be administered via NPAC. The ten-digit NANP number matches the existing lengths of other number portability affected inter-network services within the NPAC. The LSMS, when receiving updates for translation types 10 and "new", will be required to send the update request to the affected nodes which contain the global title tables (i.e., the NP DB). The NP DB, upon receiving the SMS GTT update, updates its ten-digit GTT table accordingly. Note that this administration process does not have to administer eleven digit numbers.

3.3.4.15 Default Database Provisioning

For non-portable numbers, a default GTT database is needed. This default database contains the routing needs for non-ported numbers. That is, it contains the routing structure used prior to number portability. This database is provisioned by means other than the NPAC.

The default GTT table contains sufficient digits to route to the appropriate network. In most cases, GTT on the six-digit NPA-NXX will satisfy this need. Note that an LRN is not recommended in the default table since it unnecessarily uses a vital network resource and requires network agreements with each interconnecting network.

3.3.5 *Nationwide Roaming*

Roaming is essential to wireless services. The FCC *First Memorandum Opinion and Order on Reconsideration* mandates that "... by June 30, 1999, CMRS providers must... be able to support nationwide roaming."⁴⁵

⁴⁵ Paragraph 136.

Per the WNP Architecture, a ported subscriber will have a MIN,⁴⁶ as an MSID, different from the MDN. When a subscriber roams, the mobile station communicates the MIN to the Serving MSC via the air interface during registration. The MDN is transmitted to the Serving MSC from the home network HLR via protocol message transaction – via the IS-41 RegistrationNotification Return Result, for example. It is assumed that if the home network is capable of supporting a subscriber with a MIN not equal to the MDN, the home HLR is capable of transmitting the MDN to the Serving MSC. If the Serving MSC has been upgraded to recognize the MDN in the registration response and store it in the VLR, then the roaming subscriber should be able to receive calls and services consistent with the service offering and roaming agreements.

In summary, independent of whether a switch carries traffic in or out of a top 100 MSA, in order for a switch to be able to distinguish between the MSID and the MDN, the following must hold true:

- The roaming subscriber's HLR can store the MSID and a separate MDN.
- The Serving MSC's VLR can store the MSID and a separate MDN for the roaming subscriber.
- The Serving MSC switch software has been upgraded to record the MSID and the MDN on the Call Detail Records (CDR).

3.3.5.1 Service Impacts

However, if the Serving MSC has not been upgraded to recognize the MIN as separate from the MDN, it will not be capable of receiving and storing the MDN. It will, therefore, continue to treat the subscriber's MIN as the telephone number. As a result the following capabilities will be degraded:

- *Automatic Number Identification (ANI) or Charge Number* – The WNP Solution recommends that the ANI or Charge Number (CHN) equal the MDN for all wireless calls. Maintaining the ANI or CHN as the telephone number is essential for consistent long distance carrier recording and direct billing. If the ANI or CHN is set to the MIN, one of two things may happen:
 - (a) If the MIN is equal to some other's MDN, the wrong subscriber may be billed for the call. This scenario opens up the long distance carriers to potential fraud.
 - (b) If the MIN is not a NANP number, the long distance carrier may not be able to bill the call at all, or may even drop the call.

Other services that are dependent upon the ANI or CHN being a telephone number may also be impacted.

- *Calling Number Identification (CNI)* – Calling Number services are based on the Calling Party Number being equal to the telephone number, the MDN. If the Serving MSC only

⁴⁶ MIN is used for sake of clarity in this paragraph but does not preclude the use of IMSI.

knows the MIN and therefore sets the Calling Party Number to the MIN, the wrong number (potentially another's telephone number) will be displayed to the called party.

- *Emergency Services* – If the roaming subscriber dials “911” and if the Serving MSC only supports the MIN, the Serving MSC will present the MIN to the Public Safety Answering Point (PSAP) which may be an incorrect callback number. Refer to §3.3.3 for more information on the impacts of the MIN/MDN Separation on Emergency Services.
- Any other MDN-based services (e.g., CLASS, Operator Services, Customer Care) may be jeopardized when the subscriber is roaming into a serving network which does not recognize the separation.

Due to the FCC mandate to support nationwide roaming (along with WSP business needs) and due to the need to separate the MIN and MDN in order to feasibly port wireless subscribers, wireless providers involved in roaming yet outside the top 100 MSAs must still enhance their network to serve subscribers with MINs not equal to MDNs.

3.3.6 Recording

3.3.6.1 Call Detail Records

The following modifications are anticipated to the MSC Call Detail Records (at a high level – switch vendors may have varying formats):

- The MSID must be included on all CDRs. This includes the MSID of the Calling Party for mobile originated calls as well as the MSID of the Called Party for mobile terminated calls.
- The MDN should also be recorded for both mobile originated and mobile terminated call records. (There may exist some scenarios where a serving switch does not have the MDN, e.g., when an anchor switch holds the VLR record.)
- For originating calls, a query attempt should be noted on the CDR. If successful, the LRN, if returned, should also be recorded. If unsuccessful, the failure should be recorded.
- For terminating calls, the FCI indicator should be recorded to note if the previous network (N-1) queried as responsible.

3.3.6.2 Charge Party Number and FGD ANI

The Feature Group D (FGD) ANI and ISUP Charge Number should be the MDN of the calling party and not the MSID.

3.3.7 NPA Splits and Overlays

Number Portability has the potential to increase the impact on call processing for both wireless and wireline during the permissive dialing periods associated with NPA splits. These problems arise from the methods used to add the NPA to a seven digit dialed call during the permissive dialing period. Normally, the routing issues are complex enough during an NPA split due to

problems with the complexity of the geographic boundaries of the split and means of identifying which codes go with which NPA. Permissive dialing periods may introduce additional problems. These same issues may also exist for overlays depending on the extent of the overlay, the density of the numbers, and the decision to do 10 digit dial or not.

4. BUSINESS AND OPERATION SYSTEMS AND BILLING

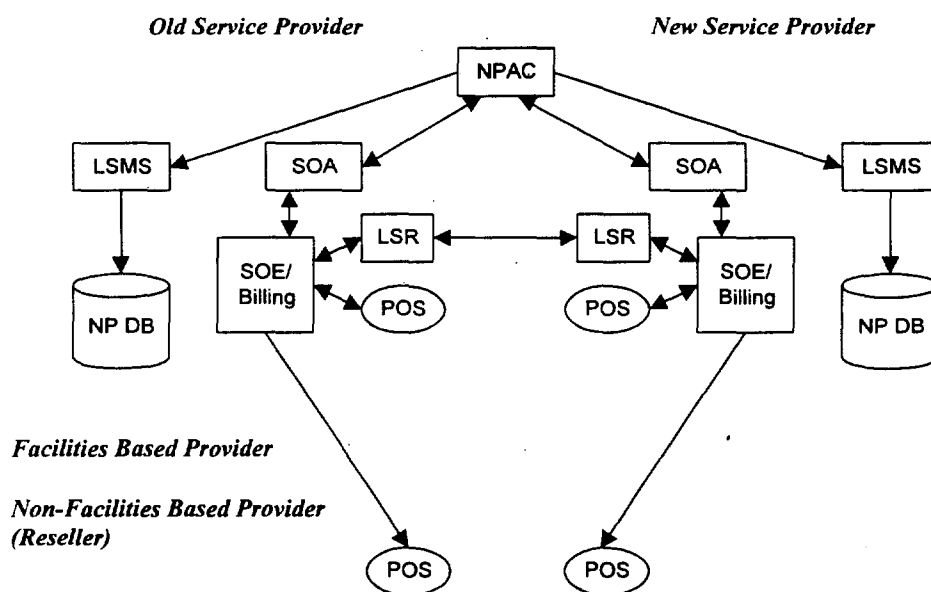
This section addresses the impacts of Number Portability on the service provider back office systems, including systems involved in number inventory management, the porting of subscribers, provisioning and billing.

This section addresses the current processes as defined by the wireline industry and endorsed by the NANC and its various subcommittees. The wireless industry requested and NANC agreed to perform a feasibility study to replace the LSR process for inter-carrier communication. Current agreement is to use the existing process in the interim until the NANC recommendation. Procedures relating to the NPAC-SMS are based on the NANC specifications, *NPAC Interoperable Interface Specification* and the *NANC Functional Requirements Specification*, and can be found on the www.npac.com web site.

4.1 Service Order and Provisioning Architecture

The components of the service order provisioning architecture are shown in Figure 4-1. The NPAC (SOA and LSMS) interfaces are subject to standardization and the LSR process is defined by the Ordering and Billing Forum (OBF). Some of the system elements shown are for completeness and are not subject to standardization. At the highest level, there are three types of business entities shown.

Figure 4-1 Basic Provisioning Architecture



4.1.1 Number Portability Administration Center Service Management System (NPAC SMS)

The NPAC SMS (a.k.a. "NPAC") is a hardware and software platform which contains the database of information required to effect the porting of telephone numbers. In general, the NPAC SMS can receive customer information from both the old and new Service Providers (including the new Location Routing Number), validates the information received, and downloads the new routing information when an "activate" message is received indicating that the customer has been physically connected to the new Service Provider's network. The NPAC SMS also contains a record of all ported numbers and a history file of all transactions relating to the porting of a number. The NPAC provides audit functionality and the ability to transmit LNP routing information to Service Providers so they can maintain synchronization of Service Provider's network elements that support LNP.

The NPAC is owned and operated by a neutral, third-party entity. Presently, there are seven logical NPACs that cover geographic areas roughly corresponding to the state boundaries associated with the seven Regional Bell Operating Companies (RBOCs). This is operated by Lockheed Martin IMS under contracts awarded by the seven regional Limited Liability Companies.

Two separate mechanized interfaces to the NPAC are defined. The interface between the NPAC and the LSMS is an open interface based upon the Common Management Information Protocol (CMIP) and is used primarily for the dissemination of routing information. The interface between the NPAC and the SOA is also a CMIP-based interface and is used primarily used by the old and new service providers to effect the porting of a subscriber. These interfaces, including the CMIP objects, as well as the functionality of the NPAC are documented in specifications maintained by the North American Numbering Council.

In addition to the mechanized interfaces, the NPAC may provide a "low tech" interface consisting of an internet accessed web page interface. This interface is provided for the benefit of carriers which are expected to have a low volume of port requests.

4.1.2 Facility Based Service Providers

These are CMRS licensed entities which own and operate facilities for providing two way communication services. In Figure 4-1, these are exemplified as the "old" (a.k.a. "donor") service provider and the "new" (a.k.a. "recipient") service provider. Each facility based service provider is assumed to be fully WNP capable. This implies they are able to communicate with the NPAC via the Service Order Activation (SOA) interface as well as generate and accept requests for the porting of subscribers.

4.1.3 Resellers

These are non-facility based providers of two-way wireless service by virtue of a reselling business arrangement with a facility based provider. Resellers are allocated blocks of numbers by the facility based provider and can provide customer service, maintains the subscriber information, and performs billing. The reseller may rely on the facility based provider to perform activation and de-activation for individual numbers as necessary. The activation/deactivation is

accomplished through non-standard communications interfaces between the reseller and facility based provider.

4.1.4 Functional Systems/Interfaces

The functional systems are used to affect the necessary provisioning between and within service providers. While the functional systems are not subject to standardization, their description is included to provide an overall view of the provision process. It should be noted that service providers have flexibility regarding how these systems are implemented.

4.1.4.1 Service Order Activation (SOA)

The SOA system implements the interface required by each facility based service provider for communicating information regarding a ported subscriber to/from the NPAC. It is involved both when a subscriber ports to or from a service provider. The SOA communicates with the facility based service provider's service order entry/billing/provisioning system(s), but the method of communications is not subject to standardization. The depiction of this system in the figure is for completeness only. The SOA interface to the NPAC is documented in the NANC Interface Interoperability Specification.

4.1.4.2 Local Service Request (LSR)

The LSR process is one method of communication between service providers. The LSR consists of specific information that is communicated to coordinate the porting of subscribers between the old and the new service provider. The use of the LSR process is determined through inter-carrier business agreements. A variety of methods may be used for transferring LSR information, including fax, e-mail transfer, or Electronic Data Interchange (EDI). It is expected that the larger facility based providers would prefer an automated version and that they would also accommodate a "low tech" version as well. Appendix B contains information regarding which fields in the LSR are to be used in porting to a wireless carrier.

For facility based providers, the LSR process, if used, would communicate internally with the service providers service order entry/provisioning/billing system as appropriate and is not subject to standardization. For non-facility based providers, the information must be conveyed to the facility based provider. While the LSR process may be used between a reseller and the facility based provider, this aspect is not subject to standardization.

4.1.4.3 Point of Sale system (POS)

This system(s) can be used by facility and non-facility based service providers to enter ported customer information. The POS functions and method of communication with the SOE system is not subject to standardization and is shown for completeness only.

4.1.4.4 Service Order Entry/Billing System

This system serves to maintain subscriber records as provided by the POS system and coordinate the porting activities to the various systems involved. Its interfaces and functions are not subject to standardization and its depiction in the architecture is for completeness.

4.1.4.5 Local Service Management System (LSMS)

The LSMS receives downloads from the NPAC with current routing information for ported subscribers. The LSMS populates the necessary NP DBs which may be deployed by a wireless provider. Both the LSMS and NP DB are not required to be deployed by a facility based service provider as arrangements can be made to access another service provider's database through contractual arrangements.

4.1.4.6 Number Portability Data Base (NP DB)

The NP DB is the database queried by switches for ported routing information. Deployment of this element is not required by each provider. Access to another service provider's database can be substituted.

4.2 Porting Business Process Flows

The business process flows describe the passing of information between service providers necessary to coordinate the porting of a subscriber. This includes various combinations between facility and non-facility based providers in both porting-to and porting-from instances. The following text illustrates some of the more common examples, but it should be noted that variations are possible. These include:

- Implementation of non-standard communication methods between a reseller and their associated facility based provider.
- Establishment of business agreements between a reseller and their facility based provider so that the facility provider handles all LSR requests on behalf of the reseller.
- The LSR process itself is subject to agreement between two carriers and can be modified or substituted with another process with their mutual consent.
- The wireless use of the LSR process may eventually be replaced with a different wireless inter-carrier communications process.

Because the wireless inter-carrier communications process is under study (i.e., replacement of the LSR process), the examples provided should be considered guidelines and not mandatory requirements for effecting the coordination of a subscriber porting. However, any communication between a service provider and the NPAC is subject to standardization.

The porting intervals when porting between wireless carriers includes a Firm Order Confirmation (FOC) response of 30 business minutes, and maximum waiting period for porting a customer to 2 business hours. The maximum number of hours for the porting process between wireless carriers is two and one-half business hours which includes the 30 business minutes for the LSR/FOC exchange.

4.2.1 Assumptions

For the examples listed below, various assumptions are made regarding the procedures.

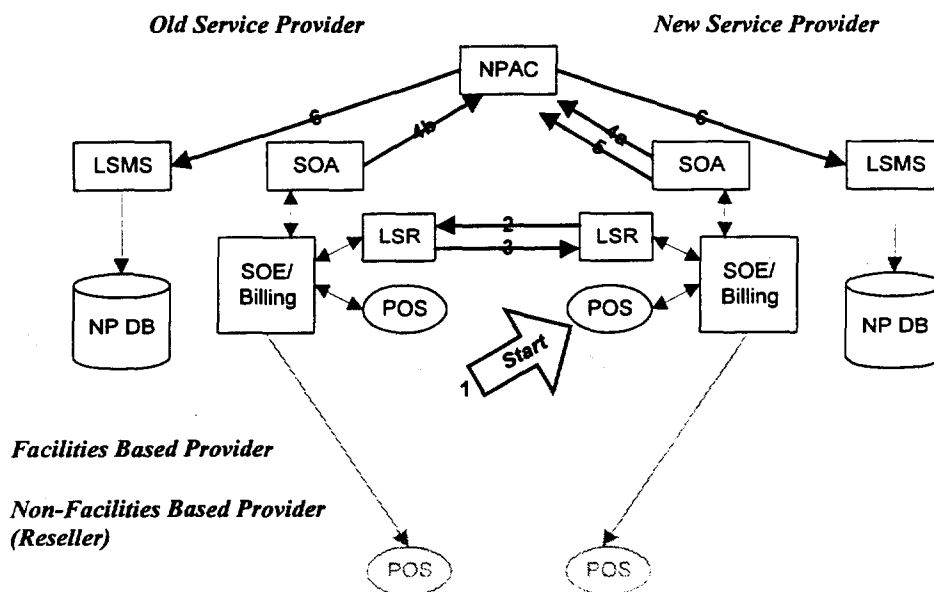
- The porting subscriber contacts the recipient provider who then initiates the porting process. While it is possible that the subscriber could initiate porting by contacting their current service provider, this is not anticipated to be the normal case.
- The examples focus on typical scenarios, but are no means complete. Various conditions, including errors, fraud situations, and time-outs can occur but are not shown. These are briefly discussed later.
- Security aspects, such as validating the recipient service provider's request, are not described.
- Resellers are obligated to support the porting of subscribers. However, resellers may have obligations regarding the porting of a subscriber that are not explicitly stated in this document.
- When porting from a reseller, the associated facility based service provider must obtain concurrence from the reseller prior to acknowledging the port to the NPAC.
- It is assumed that the old service provider does not place the order into conflict which then suspends the porting process. It should be noted this may occur for various reasons, some of which are listed.
- It is assumed that the recipient service provider has decided to accept the subscribers porting request and any credit or fraud checks have been performed.
- The examples are based on wireless service providers. The same architecture and business flows could be used to illustrate porting that involves a wireline service provider.
- It is assumed that when a subscriber ports from wireless to wireless, both WSP cooperate to effect a timely porting (e.g., less than 2 ½ hours were possible).

In the following examples, a letter following a number (e.g. "4b") indicates that the action occurs in parallel with other activities with the same number.

4.2.2 Facility-based to Facility-based Service Provider Porting

The information flow is shown in Figure 4.2. Since the two carriers involved are facility based, no reseller involvement is necessary, however, they are included in the figure for completeness.

Figure 4-2 Provisioning Flow between Two Facility Based Providers



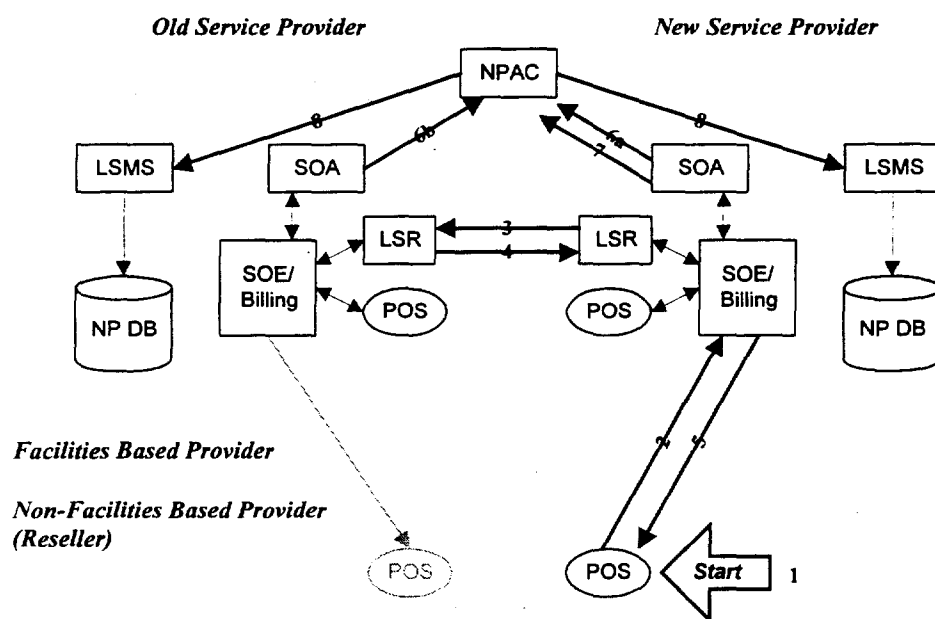
The steps are as follows:

1. The customer contacts the recipient service provider and agreement is reached to port the number. This may utilize the service providers existing Point of Sale system.
2. The recipient service provider then prepares and sends three Local Service Request (LSR) forms to the old service provider. These are the Local Request Form, End User Information Form, and the Number Portability Form. The recipient service provider indicates the desired due time on the Local Request Form for the porting of the number.
3. The old service provider verifies the information and determines that the number can be ported. It acknowledges this in the Local Request Confirmation Form.
- 4a. The recipient service provider initiates a "create" message to the NPAC indicating the subscriber's number and due time.
- 4b. The old service provider initiates a "create" message to the NPAC indicating concurrence with the port and acknowledges the due time. If the information differs from that indicated by the recipient, the NPAC initiates conflict resolution procedures.
5. The new service provider sends an "activate" message indicating that the NPAC should broadcast the updated information. The activate message must be sent after the due date indicated in the previous create message.
6. The NPAC then broadcasts the updated information.

4.2.3 Facility-based to Reseller Service Provider Porting

The information flow is shown in Figure 4.3. In this scenario, the reseller may or may not accept LSR requests directly. Smaller resellers are expected to rely on their facility based provider to exchange information with the old service provider. The communication between the reseller and their associated facility provider may be based on the LSR process or it may be based on a proprietary method of communication.

Figure 4-3 Provisioning Flow for Porting from Facilities-based Provider to Reseller



The steps are as follows:

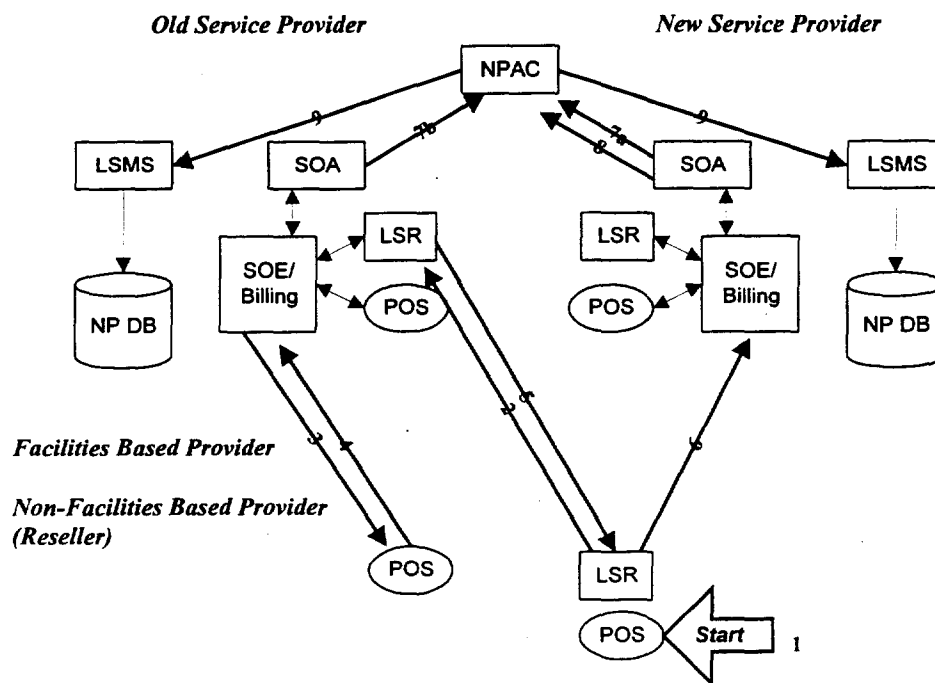
1. The customer contacts the recipient service provider and agreement is reached to port the number. This may utilize the reseller's existing Point of Sale system.
2. The recipient service provider then communicates to their associated facility provider to act as their agent in porting in the subscriber.
3. The facility based provider initiates the LSR forms to the old service provider. The facility based provider must be provided by the reseller the necessary information (such as customer name and number) to populate the forms.
4. The old service provider returns confirms the porting.
5. The facility base provider confirms that the port will take place to the reseller.

The remaining steps are as described in Section 4.2.1.

4.2.4 Reseller to Reseller Service Provider Porting

The information flow is shown in Figure 4-4. In this scenario, both the recipient resellers implements their own LSR process and does not rely on their respective facility based providers to act as their. The communication between the reseller and their associated facility provider may be based on the LSR process or it may be based on a proprietary method of communication.

Figure 4-4 Alternative Provisioning Flow when Porting from Reseller to Reseller



The steps are as follows:

1. The customer contacts the recipient service provider and agreement is reached to port the number. This may utilize the reseller's existing Point of Sale system.
2. The recipient service provider then initiates the LSR forms to the old service provider.
3. A confirming LSR is return to the new facility based provider.
4. The reseller then notifies their facility based provider that the port has been agreed to and that they should initiate the NPAC communication.

The remaining steps are as described in Section 4.2.1.

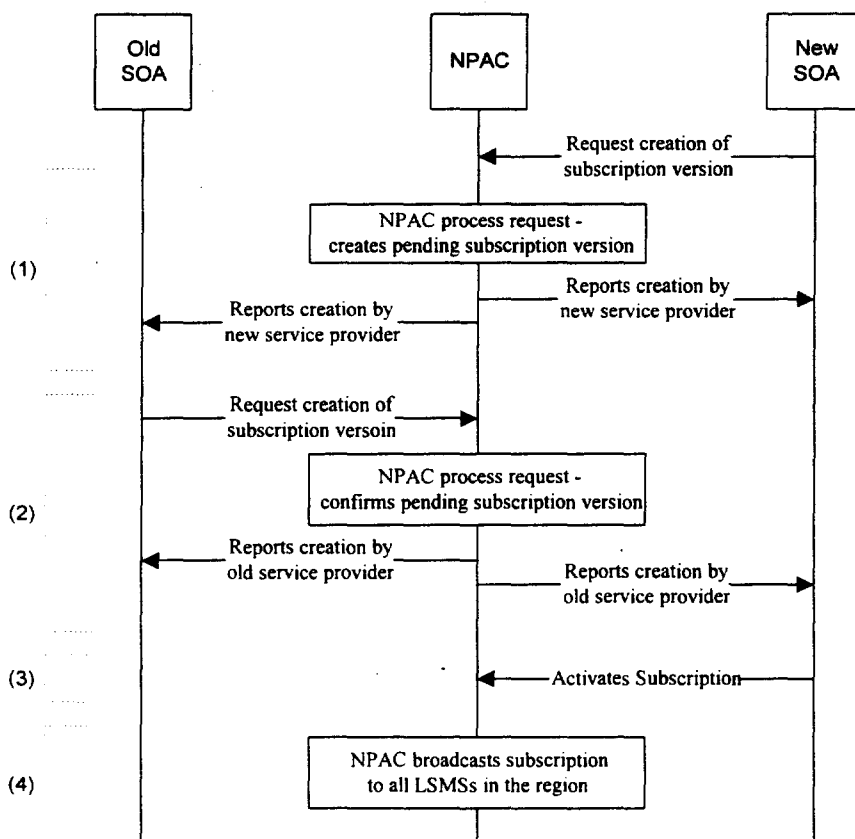
4.3 Overview of Flows between NPAC and Facility Providers

4.3.1 Provisioning

The facility based providers communicate with the NPAC to affect the porting of a subscriber. The following information further describes the communication between the facility provider and the NPAC. The information flows shown in Figure 4-5 are a high level summary based on the NANC specification of the NPAC interface as documented in NPAC SMS Interoperable Interface Specification. For complete details, the reader is referred to that document.

Flexibility is afforded regarding the order in which some of the information can be exchanged, and this section only illustrates one example. As described previously, the it is assumed that the new service provider initiates the communications to the NPAC.

Figure 4-5 NPAC—SOA Message Flows



The steps involved can be divided into four groups.

- (a) *New Service Provider Requests Create:* Since the new service provider is in contact with the subscriber, it follows that the new service provider is likely to initiate the creation of the subscription to the NPAC. The request must include:

- Ported Telephone Number
- New Service Provider
- Old Service Provider
- Due Date

Assuming the NPAC successfully processes the request, the NPAC responds to the new and then the old service provider with a confirmation that the subscription is in the "pending" state. The confirmation includes the above listed information so that the old service provider is aware of the new service provider and telephone number involved.

- (b) *Old Service Provider Requests Create:* The old service provider can explicitly confirm or deny the porting of the subscriber. If the old service provider does not respond at all within a time period, the NPAC assumes concurrence. For expediency, it is suggested that if the old service provider accepts the port, it do so explicitly and immediately.

It is possible that the old service provider can initiate the create request. In this case, the flows are very similar except that the order is reversed. However, if the new service provider does not respond with a create within a set time period, concurrence is not assumed and the process is cancelled.

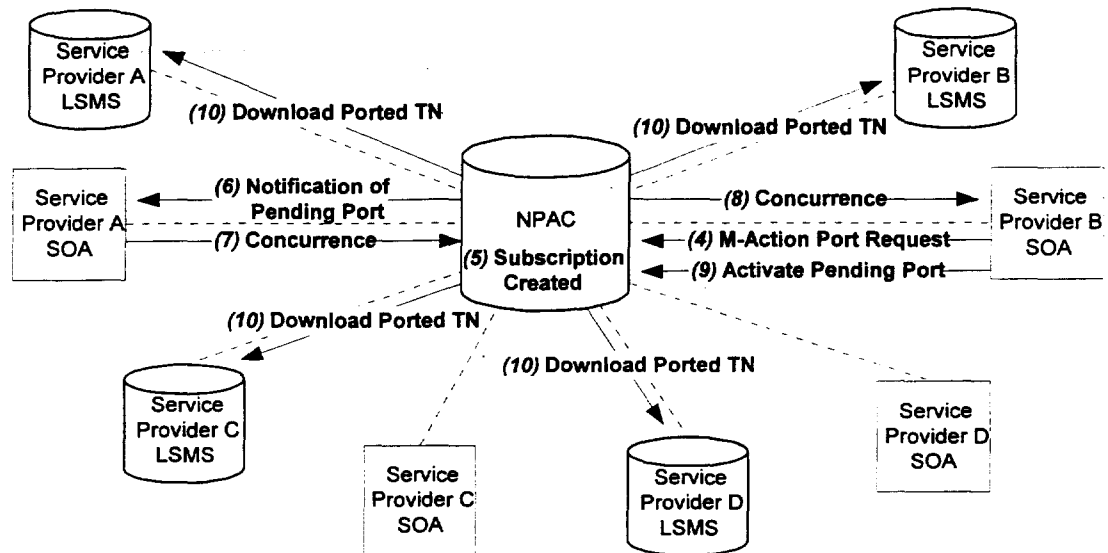
- (c) *New Service Provider Activates Subscription:* Any time after the requested due date, the new service provider can send an activate request to the NPAC. This request signals to the NPAC to download the data. If the activate is sent prior to the agreed to due date, the activate request is ignored.

- (d) *Downloading of Data:* The NPAC then broadcasts the associated ported number information to the various LSMSSs. This step is not explicitly shown on the figure.

The above message flow shows a typical example. In reality, many variations and error handling procedures are possible. In addition, each of the above messages is confirmed under normal conditions, but these are not shown.

As a summary, the figure below illustrates an example of the porting process.

Figure 4-6 Summary of the Porting Processing



Subscriber of Service Provider A requests transfer to Service Provider B:

- (1) Service Provider B completes an LSR and transmits it to Service Provider A.
- (2) Service Provider A responds to the LSR with an FOC.
- (3) Service Providers process the order internally and make ready switch, HLR, and internal systems.
- (4) Service Provider B initiates an 'M-Action' placing the porting order to the NPAC.
- (5) The order of 'subscription' is created in the NPAC database thereupon establishing a pending port.
- (6) A notification of the pending port is transmitted to the Service Provider A SOA.
- (7) Service Provider A can execute the following:
 - Transmit a concurrence via its SOA
 - Transmit a conflict notice via its SOA.
 - Transmit a cancel notice via its SOA.
 - Do nothing.

- (8) This example assumes that Service Provider A concurs and transmits a concurrence notification to the NPAC SMS.
- (9) On or after the effective due date/time, Service Provider B transmits an activate message for the pending subscription.
- (10) Notification and subscription data is downloaded to all Service Providers' LSMSs which are connected to the NPAC network.
- (11) The download is acknowledged by each service provider.
- (12) Once each service provider has acknowledged, the subscription is considered active and all service providers had updated their network elements (SCPs, STPs, etc).

4.3.2 Other Functions

The NPAC-SOA interface is used to provide a variety of other functions. These include:

- *Service Disconnect* -- this allows disconnected ported numbers to be returned to the original code holder for future reassignment.
- *Service Repair* -- the ability to receive indications of problems and perform audit functions.
- *Conflict Notification/Resolution* -- the ability for one of the parties to refuse the porting of a subscriber.
- *Disaster Recover and Backup* -- the ability to recover from disasters and outages.
- *Service Order Cancellation* -- the ability to cancel a subscription.
- *Audit Request* -- the ability to audit data contained in a service provider's NP-DB.
- *Data Administration* -- the ability of service providers to request data/reports from the NPAC.

For complete information regarding the NPAC functionality and operation, the reader is referred to the NANC NAPC-SMS Functional Reference Specification and the Interoperable Interface Specification.

4.4 Number Administration

Three numbering resources are involved in WNP: Mobile Identification Numbers (MIN), Mobile Directory Numbers (MDN), and International Mobile Subscriber Identifiers (IMSI)

4.4.1 MIN Administration

Prior to number portability, the MIN was the same value as the MDN and there was no need for a separate MIN administrator. Since the values are now separate, MIN administration is a vital new function.

Currently, draft MIN administration guidelines are being developed by CTIA for adoption by the wireless industry. That document describes the process and functions of the administrator. On the date that number portability officially starts, all the MIN values that a service provider are currently using are automatically "grandfathered", i.e. programmed MIN values in mobile sets are automatically assigned to that service provider. No mass reprogramming of mobile sets is planned. However, once the MIN and MDN are separated, any subsequent MIN values programmed into a mobile set will have to be obtained from the MIN Administrator.

It is envisioned that the MIN Administrator will allocate blocks of 10,000 values which corresponds to the number of telephone numbers in a central office code block. This allows the first 6 digits of the MIN to uniquely identify a service provider and minimizes SS7 routing procedures for registration. Mobile sets will be programmed with a MIN, but it may not be the same value as the associated MDN.

It is possible that whenever a NPA-NXX block of telephone numbers is allocated to a wireless carrier, the MIN administrator will attempt to assign the corresponding block of MINs. However, the details of this have not yet been finalized.

4.4.2 MDN Administration

4.4.2.1 Current Administration

The administration of telephone numbers was historically done at three levels:

- Number Plan Administration (NPA) - administered by Bellcore on a national basis
- Central Office Code (NXX) - administered by the dominate LEC in each area
- Line Level (XXXX) - administered by the service provider

Effective January 19, 1998, the administration of NPAs is performed by Lockheed Martin, as the new North American Numbering Plan Administration (NANPA), and during 1998 and 1999 the transition of Central Office Code Administration, including NPA Relief Planning, will migrate as well. During this period, wireless carriers will continue to administer line level numbers. The change of numbering administrators by itself does not impact wireless number portability.

4.4.2.2 Number Pooling

With the implementation of number portability, specifically the support of routing via an LRN, the communications industry is migrating towards the implementation of number pooling. The intent is to provide more efficient utilization of numbering resources. Whereas number portability is the capability of porting assigned telephone numbers, number pooling can be described as the porting of unassigned telephone numbers.

Under this scheme, service providers will be allocated blocks of numbers on a 1000-number basis, effectively sharing a central office code other service providers. Number pooling also requires the separation of the MIN and MDN. With number pooling, wireless carriers would be required to obtain MIN resources to program into the mobile sets in order to preserve 6 digit routing within the SS7 network.

4.4.2.3 Disconnecting Ported Numbers

When a ported wireless subscriber terminates service (i.e. does not port but rather drops service altogether), the WSP must provide appropriate call termination treatment (e.g., intercept). Intercept treatment is usually indicated by removing the profile of the subscriber in the HLR. When the mobile switch queries the HLR, the absence of a customer profile triggers the intercept message. During this period, no changes are indicated to the NPAC-SMS and calls will continue to be routed to the WSP via the LRN in the NP-DB.

After the period of providing intercept expires, the serving WSP then notifies the NPAC-SMS that the portable number entry should be removed. The NPAC then effectively removes any association of the number to an LRN and broadcasts this to all the LSMSs and routing to that number reverts to the service provider that was allocated the NPA-NXX associated with the disconnected number. Once this occurs, the original service provider may then reassign the number to a new subscriber. This process of releasing the disconnected ported number has been referred to as “snap back to the code holder.”

4.4.3 Location Routing Number Assignment

As number portability routing to an MSC is based on the LRN, each MSC shall be assigned at least one LRN. A WSP may designate a single MSC in the serving area as a single point of entry for incoming calls for ported subscriber (e.g., a gateway MSC). In this case, the gateway MSC would require at least one LRN value for other networks to route calls. Once the MSC receives the call; it may invoke existing wireless procedures for obtaining a temporary routing number to complete the call. The MSCs behind the gateway do not require LRNs.

Alternatively, a WSP may choose to allocate at least one LRN for every MSC in the serving area which would result in routing calls to various MSCs and eliminating the concept of a gateway MSC. If multiple MSCs share the same code block (i.e., NPA-NXX), then a unique LRN is needed to identify each MSC.

Specifically, the Industry Numbering Committee⁴⁷ advises assigning one LRN per LATA boundary to preserve routing and rating across LATA boundaries. As wireless MSCs span multiple LATAs in some cases, it may also make sense to assign LRNs per Point of Interconnect (POI) to also preserve the unique routing and associated rating for call connection and completion. Such an assignment may be based upon interconnection agreements with the LECs. Additionally, there may exist some services (e.g., NPA-NXX based services) for which assigning an LRN specific to routing for that mobility service may make sense.

The WSP must select LRNs for a particular switch from those NPA-NXX codes already assigned to that switch. If multiple NPA-NXXs exist, then LRNs may be selected from any of these values. Furthermore, as the LRN must be a 10 digit number, the service provider may select any line number value.

⁴⁷ Industry Numbering Committee *Location Routing Number Assignment Practices*, Issue No. 102.

4.4.4 Steps for opening an NPA-NXX for Portability

Various steps are necessary prior to a WSP being able to participate in number portability. Although not all the details are described, three key steps are necessary:

- Initiate a formal request to other carriers for portability
- Open an NPA-NXX for portability
- Activate the query trigger

4.4.4.1 Initiating a Request for Portability

This process involves a formal notification to the carrier (either wireline or wireless) serving the MSA in question to provide number portability in their switch(es) serving the MSA. The FCC has described timetables by which the designated switches must be provisioned for number portability. The agreement in the wireline industry is on a switch requested to be made LNP capable, all NPA-NXXs should be made available or opened for number portability. This will not hold true for wireless, given that a wireless switch likely serves NPA-NXXs outside the MSA in question. This will lead to a need for WSPs to identify beyond the switch level, the NPA-NXXs subject to portability in the specified area.

The wireless industry is investigating options to facilitate the logistical process of requesting portability. One option recommended is to employ the services of a “clearinghouse.” At a high level, the function of the clearinghouse would be to accept the request from a WSP and forward the request to the appropriate carrier. Its anticipated function is to facilitate the logistical process, such as the sending of certified letters of notification, maintaining the appropriate name and address contact for each carrier, tracking and logging responses, etc. Alternatively, this function could be handled one-on-one between carriers. In any case, the TCC LNP order specifies that cellular, broadband PCS, and covered SMR providers must make available lists of their switches for which deployment has and has not been requested.

4.4.4.2 Opening an NPA-NXX for Portability

Once a number block is identified for portability, it must be opened for portability. Population of the NPA-NXX in the NPAC SMS as described in the FCC approved NANC flows is the process to accomplish this. This process and the associated flows are documented in the LNPA WG Report to the NANC, dated April 25, 1997 and forwarded to the FCC on May 1. The population of the NPAC SMS can be done in real time. Although the FCC approved flows do not specify population of the LERG with the NPA-NXX portability identification, the LERG is currently being updated for this purpose by carriers participating in number portability. Given the initial carrier request for portability (step 1) should be made 9 months in advance of the FCC directed implementation date. This allows adequate time for industry notification of LNP targeted NPA-NXXs.

4.4.4.3 Activating the Query Trigger

The third step in the process is to activate the query trigger for that NPA-NXX. This process is driven by the FCC approved NANC flows described as the “First TN ported in NPA-NXX”

process. The industry decided to separate the activation of the query from the opening of the NPA-NXX for portability. This was to avoid forcing carriers to query on calls to NPA-NXXs where there are no ported customers. The industry agreed on this process based on the first ported number in the NPA-NXX, allowing 5 days for all carriers to activate the triggers for that NPA-NXX in their switches.

This is a separate and distinguishable step from designating an NPA-NXX as ready-for-porting or, equivalently, opening an NPA-NXX for portability. A carrier may choose to activate the triggers in their own switches prior to a first port notification (e.g., based on data published in the LERG); however, carriers are under no obligation to do so. It will be at the discretion of the WSP as to when to provision their network to query the NPA-NXX designated for portability. The activation process and query cost recovery approach of the interconnecting LEC may impact the WSPs decision.

4.5 Billing Aspects

The billing function is comprised of three distinct systems: a Service Order System, a Message Processing System, and a Billing System. This section discusses the impacts of Wireless Local Number Portability on each of these systems.

4.5.1 Service Order Systems

Within a typical Service Order System, an inventory of directory numbers is maintained and constantly updated due to the addition of new directory numbers, assignment of existing numbers for new activations and the release of existing numbers for deactivations. With the split of the MSID and MDN, two inventories will need to be maintained instead of just one and two separate requests for number resources will have to be generated when either additional MSIDs or MDNs are needed.

Provision will also need to be made for assignment of both an MSID and MDN for new, non-porting subscribers and assignment of just an MSID for new, porting subscribers. Also, for new, porting subscribers, the directory number that they bring with them may need to be added to the MDN inventory prior to completion of the service order depending on the edits in place in the system. Provision must also be made for "snap-back" functionality if a subscriber discontinues service with a ported number.

Generation of CARE records is typically initiated by service order activity. The CARE record format, which is maintained by OBF, has been updated to include specific fields for wireless carriers and for number portability. The Local Service Request (LSR) form, also maintained by OBF, could also be generated from information gathered for service order processing.

4.5.2 Message Processing Systems (MPS)

Message Processing Systems generally process all usage generated by home and Roaming customers. This includes inputs from such sources as switches, the roaming clearinghouse, any adjunct systems such as Short Message Service Centers, LECs, and IXC. Outputs may be generated for a number of users such as LECs, IXCs, the roaming clearinghouse, fraud systems,

alternate billing systems, etc. Changes to support LNP will affect most, if not all, of the data passed from and to these systems.

Specifically, changes have already been identified for switch records (changes will vary depending on switch vendor), Cellular Inter-Carrier Billing Exchange Roamer records, maintained by CIBERNET (see Section 3.3.5), and EMR/EMI records, maintained by OBF. New edits will be required to validate the data in the new fields and/or modules in these records.. New data from modified inputs may need to be included in the proprietary internal billing records which will cause major changes to many of the MPS programs. In addition, a number of new reports may be required to support changes to the business due to Local Number Portability.

Another function of MPS, in some designs, is to "guide" usage to the correct billing number. Changes will be required to this process to be able to guide based on either MDN or MSID to allow for usage (such as roaming usage from switches that are not MSID/MDN split capable).

4.5.3 *Billing Systems*

If the guiding function discussed above is performed in the Billing System, then the changes required for guiding would need to be implemented in billing and not MPS. Actual invoicing should be based on the dialable directory number (MDN) as it is today and not the MSID. The MDN, not the MSID, is the number that should appear on the customer's bill. By the time the proprietary billing records get through Message Processing to Billing, they should have the same information as they do prior to LNP (they may have additional LNP related information which was used in MPS, but this would not impact billing). The greatest changes will most likely be due to the generation of LNP specific reports if necessary. With the vast number of proprietary systems and business practices, it would not be within the scope of this report to completely document the impact of LNP on billing. Therefore, each company should examine every aspect of their systems to determine how billing is accomplished, especially with regard to the MSID and MDN separation.

4.5.4 *Call Detail Record*

The switch creates a call detail record (CDR) for every call recorded. With number portability, the CDR will have to explicitly record the MDN separate from the MIN. This requires an additional field to the CDR record which must be processed by the service provider's operation systems.

In addition, the CDR should contain an indication whether the number portability query was performed by the switch for that call. Indication of the result of the dip, i.e. the LRN received should be recorded. If the query does not succeed for some reason, the CDR should indicate the error (time out encountered due to no response, incorrect LRN received, et cetera).

4.5.5 *CIBER Records*

In order to support Wireless Local Number Portability, CIBERNET held an open forum in January, 1998 to review and discuss industry comments on three proposed new CIBER (Cellular Inter-Carrier Billing Exchange Roamer) records: Type 22, Type 42, and Type 52. During the course of this meeting, it was determined that an additional Type 32 record was required. The

new Type 22 corresponds to a combination of the Type 10 and Type 20. The new Types 32, 42, and 52 correspond to the Types 30, 11 and 50, respectively. With respect to WNP, the format of the new records differ from that of the existing records in that the required fields of MSID, MDN, and LRN have been added. If the MDN is unknown, it is assumed that the MSID would either be duplicated within the MDN field or the MDN field will be populated with zeros. Additional fields were added to the new CIBER record types beyond the three mentioned above. Readers should contact CIBERNET for details.

The existing CIBER Type 10, Type 20, Type 11, Type 30, and Type 50 records will remain available for use for exchanging data recorded either by systems not required to support WNP or on switches that have not been upgraded for the MSID/MDN separation. Carriers will need to be able to send and receive both sets of records.

In addition, an existing table, the NPA-NXX LINE RANGE Table will be renamed. This table lists all NPA-NXXs / Line Ranges assigned to wireless carriers as well as the corresponding SID/BID, Market name, and CIBERNET Carrier Code. In the past, these NPA-NXXs have been used to identify directory numbers assigned to carriers. CIBERNET will rename this table to the MSID TABLE to ensure that the NPA-NXXs only refer to the MSIDs and not the MDNs.

The IS-124 Standard, also known as Data Message Handler (DMH) was developed to facilitate faster exchange of roaming usage between carriers and replace the CIBER records. All record types within the IS-124 Standard also need to be reviewed and revised where necessary so that, at a minimum, they support the separation of the MSID and MIN as well as the ability to pass the LRN when appropriate.

The impact on North American GSM operators, including possible changes to the North American TAP 2 (Transfer Account Procedures Version 2) to support WNP, has not been formally addressed at this time. However, the current structure does appear to support the required elements.

4.5.6 *Subscriber Billing*

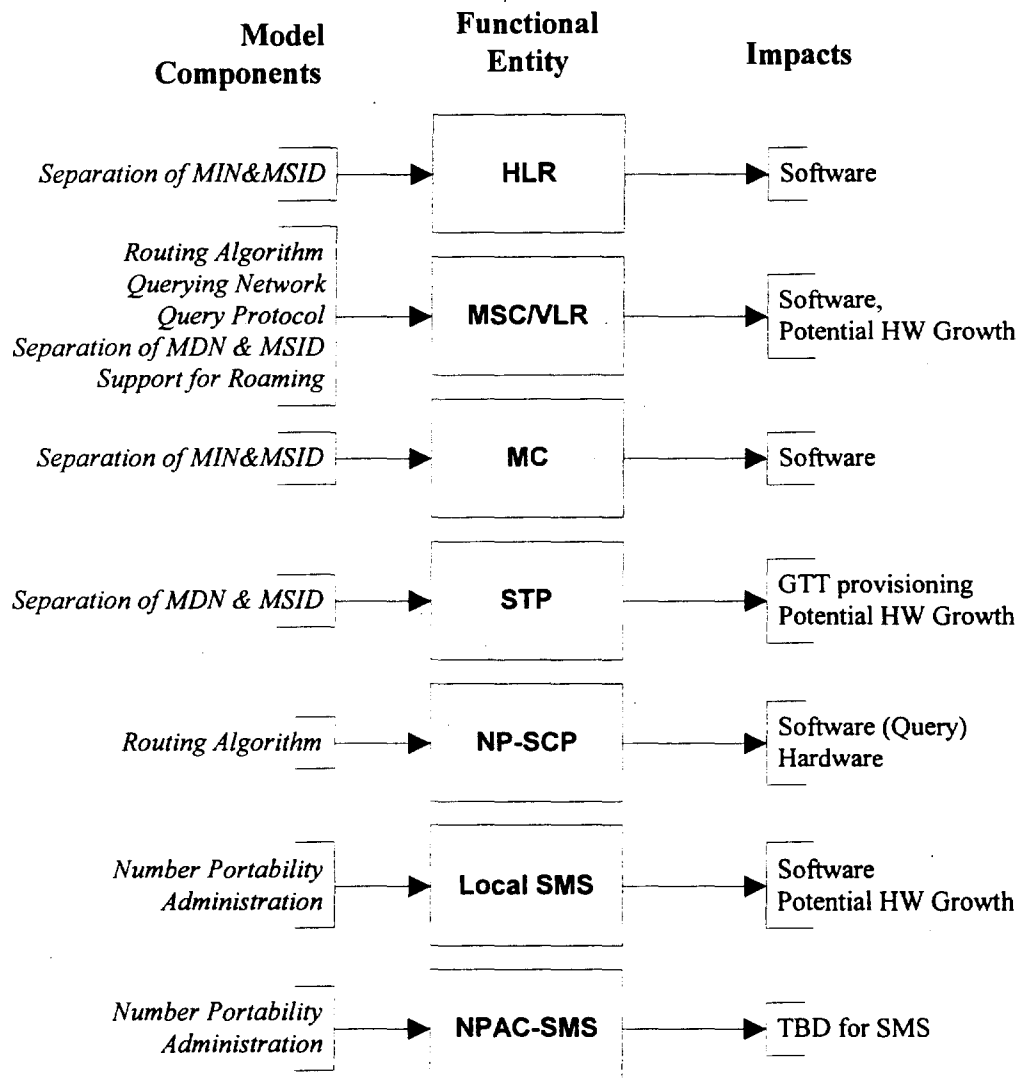
Service providers should be able to bill ported subscribers. This will require separate administration of the MIN and MDN with respect to identification of the account.

5. WIRELESS NUMBER PORTABILITY SYSTEM IMPACTS

This section summarizes the anticipated WNP architecture impacts to each of the entities in the network architecture.

Figure 5-1 maps the components of the wireless number portability building blocks in Figure 2-1 to the wireless NP functional entities (e.g., network elements, operations systems). Most entities map to only one building block; the exception is the MSC as it maps to multiple. The figure also illustrates the recommended impacts related to each functional entity.

Figure 5-1 Mapping of Platforms to Wireless Number Portability Model



5.1 Impacts to the Mobile Station

The following impacts are anticipated on the mobile stations:

- The mobile station will, at a minimum, need to contain a MSID. Specifically, the mobile station will need a MIN to register on MIN-capable networks and, if applicable, an IMSI to register on IMSI-capable networks.
- The MS will register with the IMSI on an IMSI capable network or with the MIN on MIN-capable networks. If the mobile is not IMSI-capable, it will register with MIN on IMSI or MIN networks.
- Mobile stations typically have the capability to display the telephone number to the subscriber. Therefore, it may be desirable to program the MDN into the mobile station to display the telephone number to the subscriber. However, the mobile station need not have the MDN for service or call completion. The MDN will not be transmitted over the air interface during registration. The communication with the MSC and base station will be via the MSID, only.
- If the MDN is not programmed into the mobile station, it is more desirable to display nothing than the MSID as the telephone number. Existing mobile stations may display the MIN; this may add an impact to Customer Care and subscriber education.
- Porting from one facility provider to another will require that the mobile station be reprogrammed with a new MSID, MIN or IMSI or both, as appropriate, to the recipient provider.

5.2 Impacts to the Air Interfaces

No impacts have been identified for the following air interface protocols: IS-136, IS-95 and GSM.

However, if a provider chooses to implement an IMSI network, the following impacts should be known (and is being worked on by the IS-136 standards committees):

- In the IS-136A standards, if both an IMSI and a MIN are programmed in the mobile, the MIN takes precedence over the IMSI while in the mobile's home country. Therefore, modifications to the standard are required in order to reverse the precedence, allowing IMSI to be the primary identifier in an IMSI-capable network.

5.3 Impacts to IS-41 Signaling

The following impacts to the IS-41 signaling standards are anticipated:

- All IS-41 messages which contain MIN (e.g., Registration Notification) will need to be enhanced to support the MSID parameter *if, and only if*, the IMSI parameter is introduced. The MIN parameter is already defined and encoded in IS-41 Revision C.
- All IS-41 transactions which are based on identifying the subscriber based on their telephone number (as opposed to mobile station identification) should use the MDN where MIN was used prior to number portability.

- All IS-41 transactions which are based on mobile station identification should use the MSID (or MIN as appropriate) where MIN was used prior to number portability.
- The contents of the *Digits(Dialed)* parameter in the IS-41 messages (e.g., LocationRequest) should be interpreted as the MDN, not the MIN.
- IS-41 will need to be enhanced to support Automatic Code Gap (ACG).
- Incorporate a new message for querying a LNP database. TR45.2 has standardized⁴⁸ the NumberPortabilityRequest query and response message set.
- MIN is currently a mandatory parameter in the SMSRequest and SMSNotification messages. For SMS in WNP, the appropriate value (for what is a MIN today) will be the MDN. The SMSREQ message should be modified to require the MDN.

5.4 Impacts to GSM-based PCS 1900

GSM-based PCS 1900 is a mixture of ANSI protocols and international SS7 protocols to provide service in North America. For example, GSM-based PC 1900 uses the international SS7 Mobile Application Part (MAP) but interfaces it with the ANSI versions of TCAP and ISUP.

The GSM-based PCS 1900 signaling modifications to support WNP involve two areas. The first area involves ISUP which is based on the same modifications adopted for wireline portability. These include the following⁴⁹:

- new FCI bit indication for translated number
- new GAP code point to indicate Called Party Number

The other change involves the MAP. The changes include the following:

- a definition of a query message and response (T1.708)
- incorporation of ACG protocol and procedures

As recommended in Short Message Service §3.3.4, GSM network will need the following Short Message Service support:

- A new DN-to-MC translation type that is used jointly with IS-41
- Administration of a service SS7 subsystem number and point code each ported number via the NPAC-SMS

Note that the GSM Subscriber Identify Module (SIM) card provides a DN for connection to the Home MC for that subscriber.

In the case of special of temporary numbers used for GSM-based PCS 1900, the following the numbers should not be portable:

⁴⁸ ANSI-41 Addendum for Wireless Number Portability, PN-3980A.

⁴⁹ ANSI T1.xxx – 1998, *American National Standards for Telecommunications – Signaling System Number 7 – Number Portability Call Completion to a Portable Number.*

- Hand-over numbers (HON) used to hand over calls between service providers during a call as it cross RF boundaries
- Mobile Station Routing Numbers (MSRN) used to delivery calls to the serving network.

5.5 Impacts to the Home Location Register

The WNP architecture notes the following impacts on the HLR:

- Mapping between MSID and MDN

The HLR must provide a mapping between the MSID and the MDN for subscribers. For example, the HLR must map the MDN received in the LocationRequest to an MSID. The MSID is then sent to the Serving MSC/VLR requesting a TLDN.

The NPAC-SMS will not provide the HLR provisioning information for the assignment of a porting MDN to a network owned MSID. Existing systems will need to make this assignment upon notification/validation that a subscriber is porting into the wireless network. The assignment can be made prior to the NPAC-SMS broadcast provisioning window.

- The MDN should be made available to the MSC/VLR at the time of registration in the RegistrationNotification Return Result (or equivalent); this is an absolute requirement for subscriber's whose MSID and MDN are not equal.
- If multiple MDNs are used for the same MSID, the HLR must designate one MDN as the preferred MDN for the domestic network.
- The HLR must support any enhancements to the IS-41 (or equivalent) messages required to accommodate MSID, MIN, MDN, and IMSI, as appropriate.
- The HLR should indicate to the MSC whether the destination digits in the Location Request Return Result are a TLDN or another type of digits (e.g. Call Forwarding digits).
- Querying the NP DB Before the HLR

Querying the NP DB before the HLR alleviates the need for the MSC to query the HLR for calls to ported numbers not resident on the querying MSC and for calls to wireline subscribers within a portable NPA-NXX. That is, if the response returns an LRN not associated with the MSC, or it returns no LRN and the NPA-NXX is a portable NPA-NXX not associated with this network, then there is no need to query the HLR. The amount of required HLR capacity is therefore significantly reduced in high call volume areas by eliminating this unnecessary HLR query volume.

5.6 Impacts to the Mobile Switching Center

The MSC is impacted in multiple areas including registration/validation, call origination, call delivery, roamer tables, digit screening, query capabilities, and others. Some of these items are detailed below.

To ensure the Calling Number Identification Presentation (CNIP) service continues to deliver the appropriate number to the called party the MSC must populate the calling party number parameter with the MDN in the ISUP IAM.

5.6.1 Registration/Validation

The impacts on the MSC due to the proposed WNP architecture, pertaining to the MS registration and validation, are the following:

- The MSC must support (or at least portions of) IS-41 Revision C (or equivalent) protocol for the Mobile Application Part if the MSC is to perform NP functions.
- The MSC must send the registration request to the HLR requiring GTT of the MSID digits at the STPs.
 - IMSI will use a TT of 9, and MIN will use a TT of 3.
 - IS-41 Revision C must be modified to include the MSID in place of the MIN as a mandatory parameter in the RegistrationNotification message.
- The MSC will receive an HLR response to the registration/validation message which is MTP routed from the HLR. The profile macro in the response message must include the DN of the MS.
- The MSC must be able to differentiate between MSID and MDN and to store them in the call register.

5.6.2 Call Origination

The impacts on the MSC due to the proposed WNP architecture, pertaining to the MS call origination, are the following:

- The originating MSC must populate the CgPN in the ISUP IAM with the MDN. This MDN is obtained from MS's HLR in the response to the registration response.
- The originating MSC must populate the Charge Party Number in the ISUP IAM with the MDN. This DN is obtained from MS's HLR in the response to the registration response.
- If the CdPN belongs to a ported NPA-NXX block in the MSC's serving area, then the following must hold true:
 - The MSC will query the NP DB using the WNP Query message to obtain the LRN of the entry switch of the ported number.
 - The MSC must be able to interpret the response received from the NP DB. The response contains the LRN for ported DNs and the dialed DN for non-portable DNs.
 - Upon receiving the LRN, the MSC must send an ISUP IAM message, to the next switch with the "m" bit set in the FCI, the CdPN set to the retrieved LRN, the CgPN set to the MDN of the calling party, and the GAP parameters set to the dialed DN.

- If the dialed number is not ported, the NP DB will respond with an indication in the response message as dictated by the protocol to route on the dialed DN. The MSC must be able to process this message. No GAP parameter is required in this circumstance.
- If MSC determines that it is an inter-LATA call, it must route the call to the appropriate IXC for further processing using ISUP or Multi-Frequency (MF) trunk set up messages. The IXC may then perform the query to the NP DB.

5.6.3 Call Delivery

The impacts on the MSC due to the proposed WNP architecture, pertaining to the MS call delivery, are the following:

- The MSC must be able to process the IAM parameters, including the FCI *m*th bit and the GAP.
- The MSC pointed to by the LRN (i.e., entry MSC) must recognize the LRN in the CdPN as its own. It must then replace the CdPN value with the GAP value. This new CdPN will then be processed by the MSC as usual.
- The MSC will send a query to its HLR based on the MDN received from the ISUP message. Since the MDN is different from MSID and since multiple HLRs may support be supported at the MSC (for some networks), a special translation of the DN may be needed to locate the HLR.
- When setting up the trunk to the Serving network, the MSC must populate the IAM message with the CdPN equal to the TLDN, the ANI or CHN (if any) equal to the MDN, the GAP equal to the MDN, and the FCI indicator as set (no query is necessary during this leg of the call).
- If the call is forwarded to another number, the entry MSC must treat the forwarded number as a new dialed number and follow the LRN solution. Thus, if the forwarded number is within a ported range, the MSC will query the NP DB to get the LRN of the destination switch.

5.7 Impacts to Interconnection Types

There are two basic types of interconnection used by wireless carriers for interconnecting with the PSTN^{50 51}, Type 1 and Type 2. Type 1 and Type 2 trunks can be used for interchanging traffic in both directions, i.e. wireless-to-wireline and wireline-to-wireless. A description of these interconnection types and the impacts of WNP follows.

⁵⁰ EIA/TIA IS-93 *Cellular Radio Telecommunications A₁-D₁ Interfaces Standard*

⁵¹ Bellcore GR-145 *Compatibility Information for WSP-LEC Interconnection*

5.7.1 Type 1

Type 1 interconnection is a trunk interconnection between an MSC and a wireline End Office switch and can support interchange of traffic between the MSC and the PSTN. This includes traffic to and from customers served by that Type 1 office, traffic to and from other end offices and MSCs in the local network, and traffic to and from long distance carriers. Type 1 trunks also support interchange of other types of traffic (i.e., ancillary traffic) such as operator services, directory assistance, and emergency service access (i.e., 911).

Since Type 1 trunks are configured as trunks with line treatment (TWLT) at the Type 1 end office, they can only support MF or ISDN access signaling and not SS7 ISUP signaling. Therefore, the substitution of the LRN in the CdPN, and the use of the FCI and GAP parameters proposed in the SS7 ISUP IAM for NP cannot be supported by Type 1 trunks. Consequently, providers using Type 1 trunks for wireless-to-wireline calls following an NP DB query by an MSC will lose the benefit of the query.

Type 1 trunks can continue to be used for wireless-to-wireline calls (including wireless-to-wireless via the wireline) in an NP environment in the following instances:

- (a) where a WSP establishes a business agreement with the Type 1 service provider to perform the NP queries,
- (b) for calls to non-ported NPA-NXXs,
- (c) for long distance calls where the IXC, and not the Type 1 service provider, would perform the NP query, and
- (d) for ancillary services such as operator services, directory assistance, and emergency service access.

Type 1 trunks can also continue to be used for wireline-to-wireless calls (including wireless-to-wireless via the wireline) in an NP environment where there exist no ported numbers within the entire NPA-NXX in the WSP's Type 1 number range.

If type 1 interconnects are to be replaced with an interconnection type such as type 2A-SS7 to support the LRN call routing method, the MSC will need to be re-homed from the end office to an access tandem.

5.7.2 Type 2

There are multiple Type 2 interconnections, i.e. Type 2A, 2B, 2C & 2D.

- Type 2A interconnection is a trunk interconnection between an MSC and a wireline tandem switch, and can support interchange of traffic between the MSC and the PSTN. This can include traffic to and from end offices and other MSCs served by that Type 2A tandem switch, and traffic to and from long distance carriers if the Type 2A tandem also serves as an access tandem. Type 2A trunks can operate with MF or SS7 ISUP signaling. To support NP, Type 2A trunks must be converted to SS7 ISUP in order to be

able to send and receive the LRN in the CdPN, and the FCI and GAP parameters in the SS7 ISUP IAM.

- Type 2B interconnection is a trunk interconnection between an MSC and a wireline end office switch, and can support interchange of traffic between the MSC and only customers served by that Type 2B office. Type 2B trunks can operate with MF or SS7 ISUP signaling and are usually provisioned to allow overflow traffic to route to an associated Type 2A trunk group. To support NP, Type 2B trunks can remain MF as long as none of the NPA-NXXs served by the Type 2B end office or MSC contain any ported numbers. Further, the Type 2B end office and MSC can perform an NP DB query with the result indicating that the call should be routed to a Type 2B trunk group. Again, MF signaling can still be used in such cases as long as the Type 2B end office and MSC can retain the LRN for use with the associated Type 2A overflow trunk group, should all of the Type 2B trunks be found busy. Type 2B trunks can be converted to SS7 ISUP and optionally arranged for sending and receiving the LRN in the CdPN, and the FCI and GAP parameters in the SS7 ISUP IAM.

WSPs can make business arrangements for another provider to query and properly route the call to the ported-to network.

- Type 2C interconnection is a trunk interconnection between an MSC and an E911 tandem for Emergency Service calls. Signaling over Type 2C trunks is not impacted by WNP. Emergency Services feature interactions with WNP are covered in section 3.3.2.
- Type 2D interconnection is a trunk interconnection between an MSC and an Operator Tandem. Signaling over Type 2D trunks is not impacted by WNP. Operator Service feature interactions with WNP are covered in section 3.3.1.

5.8 Impacts to the Signaling Transfer Point

Note: It is recommended that all service providers utilize the GTT capability at their STPs for routing SS7 queries. Although MTP routing capability can be used, it will not be able to utilize all of the performance and administrative benefits of GTT.

The proposed NP architecture will have the following impacts on the STPs in the SS7 backbone network:

- If LRN GTT is used, STPs must support the new TT value (11) for routing WNP query messages to the NP DB.
- The STPs shall perform appropriate SS7 route and SCCP management for routing queries.
- If IMSI is implemented, the STPs must support GTT of IMSI for the new IMSI TT. Although IMSI has 15 digits, the STPs may need to perform GTT only 6-digit GTT on IMSI to locate the home service provider's network. If the home network supports multiple HLRs for the same mobile network code of the IMSI, it may have to perform GTT on greater than 6-digits of the IMSI in order to locate the HLR for the MS. Only the IMSI digits needed to perform GTT are required in the SCCP CdPA. The complete IMSI value used by the end application should be provided in the TCAP.

- STPs must have route-sets defined for every possible destination network with which the service provider has a roaming agreement.
- STPs should be able to support DN-to-HLR routing translation based on a new intra-network TT yet to be defined.
- STPs will perform Intermediate GTT (IGTT) for messages to remote network nodes and Final GTT (FGTT) for routing to the local network nodes.

5.9 Impacts to Global Title Translation

The impacts below apply to the location of GTT databases within a network. These impacts only apply to networks that plan to use GTT for the routing and management of query messages.

- The LRN GTT database is a six-digit GTT database located on the STP.
- It is perceived that MSID GTTs are STP based and are not impacted by number portability.
- MDN GTTs for inter-network service and capabilities are the most impacted in a number portability environment. The MDN GTT database may be provided on either an STP or on an SCP. Regardless of location, MDN-GTTs may require interrogation of the TCAP portion of the message to complete the GTT lookup.
- Service providers need to ensure correct and timely provisioning to avoid circular routing conditions between network elements performing GTT.
- The NP DB should provide load sharing of queries to application SCPs and Gateway STPs as necessary. The NP DB should also provide SCCP management in the case of application failures.
- MDN-GTTs on the SCP require a six-digit GTT database on the STP for each GTT database located on the SCP. This service provider managed database is used by the STP to locate the SCP performing the ten-digit GTT.
- A local SMS interface may be beneficial depending on the volume of updates received. The local SMS would provide updates for ported numbers. It is up to each service provider to update their default GTT databases for each inter-network service via existing service provider procedures.

5.10 Impacts to the Number Portability Database

The WNP solution will have the following impacts on the NP DB (some of which are already known in the LRN solution):

- The NP DB must support WNP query messages from wireless network and a response message including the LRN of the ported subscriber's MSC.
- NP DBs should be deployed with redundant replicates for total availability. This will require synchronization of the data in all replicated units to be provided by a centralized service management system.
- NP DBs should comply with Bellcore GR-1280-CORE, AIN SCP Generic Requirements, Section 11. Requirement 11-4 demands that the Mean Response Time at

the rated transaction load be 100 ms or less, and the 95% response time be 120 ms or less.

- The NP DB should implement congestion control and indicate such a condition to MSCs via ACG as to defined by IS-41 and/or GSM standards.

5.11 Impacts to Customer Care and Provisioning

The following list describes the potential impact of NP on customer care and provisioning systems, depending upon a service provider's infrastructure:

- Some system in the Customer Acquisition/Care provisioning stream must interface to the regional SMS for negotiating/announcing ported numbers with the other service provider(s) and for querying existing subscriber records.
- Any system which interfaces with the regional SMS system must do so with the enhanced format of the Customer Account Record Exchange (CARE), also known as the Inter-Service Provider Maintenance, Administration, and Provisioning (ISPMAP) information.

5.12 Impacts to Billing

The following list describes the potential impact of NP on billing and fraud management systems.

- Roaming tables may need to be modified to support both IMSI and MIN MSID formats. If the billing systems store IMSI, standard call records will also need to be modified and expanded. Additionally, telephone inventory records must be modified.
- Billing systems will most likely need to support more than one identifier for a subscriber: MSID(s) and/or MDN.
- Any system or process which is built on MIN must be modified to support another ID - rating, cycle changes, splits, et al.
- Fraud Management will also be impacted for the same reason as above. Call Detail Records from the visited service providers are currently extracted on the basis of NPA-NXX translation of the billed number.
- A billing module may have to be added to the existing AMA records for calls involving ported numbers. The details are for future study.
- A billing identifier may be added to the call setup or AMA records. Future study is required.
- Call data message handling (e.g., IS-124) needs must be addressed.

5.13 Impacts to Maintenance

The following list describes the potential impact of NP on the maintenance operations:

- Performance and measurements
- Fault Detection, isolation and recovery

- Alarm detection and alarm reporting
- Maintenance and administration position
- Test procedures of the non-ported number, ported number and disconnected ported number

5.14 Impacts to Number Portability Data Administration

The following list describes the potential impact of NP on customer and network data administration.

- Service providers need to have an EDI interface for exchanging ported subscriber's data.
- WSPs must provide for an LSMS function to mediate the data sent from the NPAC-SMS to the NP DB, including the CMIP interface to the NPAC-SMS.
- WSPs must provide for an SOA function to mediate the data sent from the WSP's service order entry systems to the NPAC-SMS, including the CMIP interface to the NPAC-SMS.
- The CTIA Cellular Operations Record Distribution (CORD) and the LERG data distribution procedure must be updated to provide rapid exchange of PC/SSN, MSID, and other pertinent routing and subscription information.
- WSPs must provide for a means (e.g., an Operations Support System, manual) with which to provision network data, including
 - portable NPA-NXX block indicator for the MSCs,
 - new TT and new GTTs in the STPs,
 - HLR updates to include ported numbers; and
 - translation data in NP DB.

5.15 Impacts to Service and Network Reliability

The porting of a customer from one service provider to another requires provisioning changes that are both accurate, timely, and precisely coordinated between all service providers in a portable area. This provisioning is especially critical with respect to GTT databases. Incorrectly provisioned GTT databases can result in SCCP circular routing conditions that may utilize all of a link set's capacity within seconds. A circular routing mechanism is therefore needed that eliminates SCCP circular routed messages from occurring.

ANSI T1.112 provides procedures for SCCP message looping in the form of the SCCP Hop Counter. This hop counter is available in SCCP X-Unitdata (XUDT) messages only. Network elements will require upgrades to support XUDT message formats. Due to economics and desired dates of implementation, the UDT message will be used for number portability and existing applications. The XUDT message has been flagged as the desired long term solution.

5.16 Human Factors Impacts

Today, mobile subscribers may dial seven digits for calls within their home NPA. An NPA is pre-pended to the dialed digits for some mobile originated calls. In a Number Portability environment, 10 digits must be sent in the query to the NP DB. Wireless Number Portability is driving the separation of MSID and MDN, with the possibility that the MSID (as MIN) will not reflect the NPA of the subscriber's MDN.

The question then is how will the MSC determine what NPA to pre-pend to a 7 digit dialed number. The call might be misrouted, or the wrong information sent to the NP DB, if the MSC relies on the MIN MSID or the NPA of the MSC to determine the NPA of the called number.

There are 3 possible solutions:

- (a) Require 10 digit local dialing for all mobile subscribers. This would treat all mobile subscribers equally (whether ported or non-portable) but may put the wireless carrier that implements 10 digit local dialing at a competitive disadvantage if the other local carriers, wireless or wireline, still support 7 digit local dialing. (A variation would be to have only the ported subscriber dial 10 digits. But that disadvantages that subscriber, would not meet dialing parity criteria, and would require the carrier to maintain multiple dialing plans for different classes of subscriber.)
- (b) Assign the ported subscriber an MSID in MIN format with the same NPA as the ported MDN. It is not clear if this would always be possible, and this practice may affect MSID administration and may lead to inefficient use of the MSID. (MIN administration is for further study.) If the mobile subscriber has an IMSI as MSID, and no MIN, the MSID provides no value for this process since an IMSI does not contain an NPA.
- (c) Use the NPA of the MDN of the calling mobile subscriber. This solution assumes that the calling party's MDN is available at the time of this substitution.

5.17 NPA-NXX BASED SERVICES

There are a number of services for wireless customers that are based on dedicated blocks of NPA-NXXs for directory numbers. These services include Calling Party Pays, reverse toll billing, and wide area calling among others. Some require agreement and interaction with a wireline carrier and apply specifically to wireline originated calls; others do not. Due to the fact that these services are based on directory numbers and directory numbers will be portable from one service provider to another, there are problems with maintaining service and billing integrity with LNP.

5.17.1 Service Descriptions

There are two applications of reverse toll billing. In one scenario, the wireline carrier bills a toll charge to customers calling wireless numbers unless the wireless numbers fall within specific ranges of NPA-NXXs. In those cases the wireless subscriber has agreed to pay the wireline toll charges. The second scenario is similar except that the wireless company pays the toll charges instead to the wireless subscriber.

Wide area calling is similar to, but just the opposite of, reverse toll billing. In this case, wireless subscribers who are assigned directory numbers within specific dedicated NPA-NXXs are allowed a larger local, toll free calling scope than other subscribers. One or more local exchange carriers has agreed., or has been ordered, to provide the larger toll-free calling scope for wireless customers with directory numbers within the dedicated NPA-NXX ranges.

Calling Party Pays is a service offered by some wireless providers which provides no airtime is charged to the wireless subscriber for incoming calls. The wireline providers identify CPP directory numbers based on dedicated NPA-NXXs and bill their customers additional charges for CPP terminated calls.

5.17.2 Possible Resolution

In the examples given, the specific wireline service providers need to determine whether or not to bill air-time or toll charges based on either an originating or terminating directory number and agreements with wireless carriers. But with LNP, the customer's directory number can remain the same while he ports to other service providers that may not participate in the agreements, or he may port into a wireless carrier with a foreign NPA-NXX which may need to be recognized as participating in a service of this type. One resolution proposed by a CTIA sponsored workshop is to assign dedicated LRNs for each of these services. The billing would then be based on the number to which the call was routed and the first six digits of the dedicated LRN would be added to the list of dedicated NPA-NXXs for that specific service.

5.18 Other Service Impacts

The following impacts to services, as known today, are anticipated with the introduction of number portability as proposed in this document:

- Over the Air Activation must support the delivery of a MDN to the MS.

The User Initiated Over The Air Function (OTAF) will not have impact with Call Origination on Wireless Number Portability. The Network Initiated OTAF with Call Termination will have some impact on Wireless Number Portability.

- CNIP must support the delivery of the MDN and not the MIN as the call party number for mobile originated calls.
- Emergency services must ensure that the subscriber is known to the operator by the MDN and not the MSID. Refer to section 3.3.2 for further discussion.
- Delivery of an SMS message to the Destination MC and ultimately the mobile station is based upon the MIN. In WNP, the delivery network only has the MDN of the mobile station. Therefore, the service is impacted in routing to the Destination MC. Refer to section 3.3.5 for presented solutions.

Impacts to CLASS type services are similar to those outlined in the ICCF document "INC Report on Number Portability," section 13.1.5.1.

There may also exist impacts to proprietary service implementations not appropriate for this document.

6. RELATED DOCUMENTS

The following documents can provide additional information regarding Number Portability:

- *Industry Numbering Committee (INC) Report on Number portability, Industry Service providers Compatibility Forum (ICCF)*, INC 96-0607-013, July 11, 1996.
- *FCC First Report and Order and Further Notice of Proposed Rulemaking*, CC Docket 96-116, July 2, 1996.
- *FCC First Memorandum Opinion and Order on Reconsideration*, CC Docket No. 95-116, March 11, 1997.
- *FCC Second Order and Report*, CC Docket No. 95-116, August 18, 1997.
- *Federal Communications Commission (FCC) Notice of Proposed Rulemaking (NPRM) for the Local Number Portability*, Docket Number 95-116, July 13, 1995.
- *Generic Requirements for SCP Application and GTT Function for Number Portability*, Illinois Number Portability Workshop, Issue 0.95, September 4, 1996.
- *Generic Switching and Signaling Requirements for Number Portability*, Illinois Number Portability Workshop, Issue 1.02, June 17, 1996.
- *IMSI Assignment Guidelines and Procedures*, Version 1, February 12, 1996.
- *North American Numbering Council LNP Architecture and Administrative Plan*, Issue 5, March 4, 1997.
- ANSI T1.660 – 1998, *American National Standards for Telecommunications – Signaling System Number 7 – Number Portability Call Completion to a Portable Number*.
- ANSI T1.708. – 1998, *American National Standards for Telecommunications – PCS 1900 Service Provider Portability*.
- *The Number Portability Administration Center (NPAC) Interoperable Interface Specification*, www.npac.com
- *The North American Numbering Council Functional Requirements Specification*, www.npac.com.
- *The North American Numbering Council Local Number Portability Administration Working Group (LNPA WG) Report on Wireless/Wireline Integration*, May 8, 1998.
- *The North American Numbering Council (NANC) Local Number Portability Administration Working Group (LNPA WG) Report to the NANC*, April 25, 1997.
- *TIA/EIA-IS-756 TIA/EIA-41 D Modifications to Support Wireless Number Portability*, February, 1998.
- *TIA/EIA-IS-756A TIA/EIA-41 D Modifications to Support Wireless Number Portability, Phase II*, release date TBD.
- *CTIA Mobile Identification Number (MIN) Assignment Guidelines and Procedures*, Version TBD, release date TBD.

- Industry Number Committee *Location Routing Number Assignment Practices*, Issue No. 102, www.atis.org/atis/clc/inc/incwdocs.htm.

Information is available via the World Wide Web regarding number portability. In some cases, the above mentioned document may be found at these web sites.

- www.fcc.gov -- information regarding the NANC LNP activities, FCC orders, meetings, etc.
- www.wow-com.com – CTIA’s web site containing copies of this document.
- www.ported.com -- this site contains various documents and information related to wireline portability.
- www.tl.org/index/0701.htm -- this site contains, among many other things, the CCPN document
- www.npac.com – Lockheed Martin’s NPAC site.
- www.atis.org/atis/clc/inc/inchom.htm – INC Working Documents.

7. ISSUES

These issues were outstanding upon release of this document, Revision 1.0. Disposition of each is recorded below.

- (a) *Issue:* How many LRNs will be assigned per MSC?

Disposition: Closed. Resolved in § 3.1.2 with additional text.

- (b) *Issue:* Are there methods wireless could employ for more efficient routing (e.g., a wireless indicator on the MDN in the NP Database)?

Disposition: Closed. It has been agreed that this topic is beyond the scope of this document at this time.

- (c) *Issue:* The impact of WNP with regard to Emergency Callback whether the call back is over a roamer access port or otherwise requires further study.

Disposition: Closed. Resolved in §3.3 with additional text.

- (d) Performance and capacity impacts should be studied.

Disposition: Closed. Service providers shall be responsible for working the performance and capacity impacts within their own networks in cooperation with their individual network element vendors.

- (e) *Issue:* How will MINs be administered?

Disposition: Closed.. MIN Administration Guidelines are currently under development. This document will refer to the guidelines, but guidelines will not be discussed in detail here..

- (f) *Issue:* It may be assumed that providing resellers with numbers in and of itself does not make these numbers ported (and thus have LRNs assigned in the NP database). However, what if a reseller wishes to resell off a different facility provider and still retain its numbers? Can a reseller port a block of numbers? What other issues will existing with resellers as a result of LNP? The treatment of resellers, resellers numbers and number portability will be noted on this issue list and addressed at some future date. Divide into two elements -- Retail porting of reseller subscribers; wholesale porting of reseller subscribers

Disposition: CLOSED. Resolved in §4 with additional text.

- (g) *Issue:* Uniform treatment by wireline providers of calls to wireless subscribers continues to be an issue. Will the rating be based on the original wireline rate center or the fact that the subscriber is being served by a WSP? This refers to the calling party. For example if moving from wireline to wireless, the original wireline number may not

get the same wide-area calling benefits as if the porting sub picks up a new number within the wide area calling number range.

Disposition: Closed. Resolved with additional text in §5.17.

- (h) *Issue:* Will notification of an NPA-NXX opening for portability in order to provision the MSC be obtained from the LERG? If so, what is the process and system impact? Will this data also be available from the NPAC-SMS, and if so, in an automatic download?

Disposition: Closed. Resolved with text in §3.1.2.

- (i) *Issue:* A standard solution (for the included alternatives or other) for delivery of a short message to a ported MDN must be chosen.

Disposition: Closed. Resolved with text in §3.3.4.

- (j) *Issue:* Impacts of WNP on Code Splits must be further studied.

Disposition: Closed. Resolved with text in §3.3.7.

- (k) *Issue:* The following implementation alternatives have been submitted for contribution in order to aid the complexities of routing a Location Request to the HLR from the gateway MSC:

- i) The MSC can translate the called MDN to the address of the called subscriber's HLR.
- ii) The SS7 Signaling network can translate the called MDN to the address of the associated subscriber's HLR.
- iii) The Originating MSC can query a NP DB to obtain the LRN, and route the signaling message to the HLR associated with the LRN.

Disposition: Closed. Resolved with text in §3.1.8.1.

Appendix A: Call Processing Matrix

1. Introduction

The following pages contain two matrices that provide background information regarding how call processing is impacted relative to which query is performed first. This information is intended to be supplemental and referential to the text. It should not be construed as implementation requirements.

The two matrices describe switch processing procedures for two cases - either the NP query is performed first or the HLR query is performed first. These are clearly marked at the top of the matrix.

2. Background Concepts

When a MSC processes a call, there is always a Called Party Number involved. The NPA-NXX portion of the Called Party Number, ("dialed code") may be classified in various ways. One way is whether the dialed code is open for portability or not. If the dialed code is "portable", then queries to a NP database should be performed, otherwise, there is no need to.

Another way to classify the dialed code is whether the code has been "opened" on the switch or not. Opened is defined as requiring a query to the HLR as a mobile subscriber may be served. . If the code is opened, then it could be "ported in" or "LERG Assigned" to the MSC. The former indicates that the code was opened due to portability, while the later indicates that the code is assigned to the MSC and was opened as part of normal operation. This distinction is critical since it impacts the assumption as to how an absent HLR profile should be treated. If the code is LERG assigned, a vacant HLR profile could be due to the number being unassigned, the subscriber having ported out, or the number being aged. If the code was ported in (i.e. not LERG assigned), then a vacant HLR profile could be that the subscriber has not ported and is served by the original codeholder, the subscriber has ported to another service provider, or the subscriber has ported to the service provider but the number is being aged.

3. Reading the Matrix

Each matrix presumes the HLR or NP query is presumed first and describes the processing of the call relative to the database contents. For example, if the HLR query is performed first, then the chart describes processing for each case of whether the HLR contains a record or not. Dependent on what the database contents is, the other query must then be performed.

The center column classifies the status of the called party number's NPA-NXX. There are four combinations possible as denoted by the "Scenario Number" on the left most column (note that the last two rows are the same NPA-NXX status and are both part of Scenario 4). Each scenario is a combination of whether the called NPA-NXX is "portable" and whether the code is "LERG Assigned" (*this presumes the code is already "opened" on the switch*).

The immediate left and right columns describe the call processing for incoming trunk calls and mobile originated calls respectively. The comments on the left and right apply respectively as well.

For each call processing situation (either mobile originated or incoming trunk), the switch processing depends on the database contents. Depending on the contents, additional queries may be required or normal call processing should occur. In some instances, the action is the same regardless of the database contents

4. Observations

Various events are possible but should be weight against their occurrence. For example, "Scenario 4B: Incoming Trunk Call" represents an incoming call from another service provider (usually the ILEC) where no LNP query has been performed. This is essentially default routing to the WSP. It is presumed that the N-1 carrier will perform the query and this scenario will be relatively rare. Consequently, engineering to optimize this situation is of little benefit.

Another situation, "HLR Query Performed First, Scenario 3, Mobile Station Origination" can lead to significant network reliability issues. In this case, the code has been opened on the switch due to a subscriber porting in. It is quite possible that hundreds of new codes will be opened on a switch to accommodate ported subscribers. If the HLR query is performed first, then any mobile originated call to that NPA-NXX would result in a query to the HLR. If only a relatively few subscribers are ported from each NPA-NXX, then the likelihood of finding a HLR record would be very small. However, every call to any number in those NPA-NXX's would result in HLR queries *and could easily cause significant HLR performance impacts*. Consequently, unless otherwise indicated, the MSC should default to performing the NP query first.

Figure A-1 HLR Query First – WNP Call Processing

Scenario	Comments	Incoming Trunk Call		Called NPA-NXX Status		Mobile Station Call Origination		Comments
		HLR Record Present	No HLR Record	Ported	LERG assigned	HLR Record Present	No HLR Record	
1	Misrouting has occurred	If LRN Present, return cause code #26 If LRN not present, normal error procedures		No	No	Route out		No need to do HLR or NP query
				(Code not resident on switch)				
2	No LRN Allowed. Receiving an LRN would be an error.	Route call normally	Vacant Treatment	No	Yes	Route call Normally	Vacant Treatment	No need to perform NP query
				(Code is resident on switch, but is not portable)				
3	LRN must be present and GAP code must match switch code list No LRN is an error.	Route call normally	Vacant Treatment	Yes	No	Route call Normally	Perform NP Query Results will dictate route call or provide intercept.	Must perform NP query to know how to handle call
				(Code is not ported into switch)				
4a	Assume LRN Present: Gap must match switch code list	Route call normally	Vacant Treatment	Yes	Yes	Route call Normally	Perform NP Query Results will dictate route call or provide intercept.	Must perform NP query to know how to handle call
				(Resident code opened for portability.)				
4b	Assume LRN Not Present. Presumes rapid removal of ported number records from HLR	Route call normally	Perform NP Query Results will dictate route call or provide intercept.	Yes	Yes	Route call Normally	Perform NP Query Results will dictate route call or provide intercept	Must perform NP query to know how to handle call
				(Resident code opened for portability)				

Notes:

"Incoming Trunk Call" means a call being delivered to an MSC over aSS7 trunk

"Mobile station Setup" means a call originated by a mobile subscriber.

NPA Status - these are two flags associated with each NPA-NXX in the MSC translation tables.

"portable" indicates the code is opened for portability and needs to be queried. This flag applies to all NPA-NXX values in the routing table (whether opened on the MSC or not).

This only applies to codes "open" on the switch (i.e., originally assigned or ported into the switch).

The above implies that the MSC differentiates between NPA-NXXs routed out of the MSC to the PSTN and codes which it serves. If the MSC implementation does not differentiate this, then a third flag would have to be defined to differentiate this.

Figure A-2: NP Query First - WNP Call Processing

Scenario	Comments	Incoming Trunk Call		Called NPA-NXX Status		Mobile Station Call Origination		Comments
		LRN exists	No LRN	Portable	LERG assigned	LRN exists	No LRN	
1	If LRN present, return cause code # 26 If not LRN present, normal error procedures	Error -cause code # 26		No	No	Route call out of switch		No need to do HLR or NP query
				(Code not resident on switch)				
2	No LRN Allowed in IAM (LRN would be an error)	No NP Query Required, Process call normally with HLR query		No	Yes	Process call Normally. Perform HLR query		No need for NP query. Do HLR query
				(Code resident but not portable)				
3	LRN must be present and GAP code must match switch code list (no LRN is error)	No NP Query Required. Process call normally with HLR query		Yes	No	Route call as LRN indicates (Route call to external switch or own switch)	Process call Normally. Initiate HLR query	Perform NP Query
				(Code ported into switch)				
4a	Assume LRN Present in IAM: Gap value must be in switch list of opened codes	Process Call normally with HLR Query		Yes	Yes	Route as LRN indicates (Route call to external switch or own switch)	Process call Normally Initiate HLR query	Perform NP Query (No LRN results in Normal Call processing)
				(Resident code opened for portability)				
4b	Assume LRN Not Present in IAM	If "own" or no LRN, initiate HLR query If "other" LRN, route call out as appropriate	Process call normally, initiate HLR query	Yes	Yes	Route as LRN indicates (Route call to external switch or own switch)	Process call Normally Initiate HLR query	Perform NP Query (No LRN results in Normal Call processing)
				(Resident code opened for portability)				

Notes:

"Incoming Trunk Call" means a call being delivered to an MSC over aSS7 trunk

"Mobile station Setup" means a call originated by a mobile subscriber.

NPA Status - these are two flags associated with each NPA-NXX in the MSC translation tables.

"portable" indicates the code is opened for portability and needs to be queried. This flag applies to all NPA-NXX values in the routing table (whether opened on the MSC or not).

"LERG Assigned" means the MSC is the codeholder of the NPA-NXX. This only applies to codes

"opened" on the switch (i.e. originally assigned or ported into the switch).

The above implies that the MSC differentiates between NPA-NXXs routed out of the MSC to the PSTN and codes which it serves. If the MSC implementation does not differentiate this, then a third flag would have to be defined to differentiate this.

Appendix B: Local Service Request (LSR) Form Usage for Inter-Service Provider Communications

1. Introduction

This appendix contains key information extracted from the workshop report.

2. Applicable LSR Forms

The Ordering and Billing Forum (OBF) is an industry forum that developed the LSR forms to provide a guideline for inter-carrier communication. OBF does not demand that all carriers exchange the pieces of information contained in the LSR forms, rather it leaves that negotiation up to the individual carriers involved in the porting process. Thus, each carrier must make individual agreements with other carriers involved in the porting process to define how and what information will be changed.

The following forms apply to the wireless carriers when porting a subscriber.

- *Local Service Request Form* -- Recipient carrier requests porting due date from donor service provider.
- *End User Information Form* -- Recipient carrier provides name/address information for donor service provider to enable cross reference between ported # and name/address.
- *Number Portability Form* -- Recipient carrier provides ported # to donor service provider.
- *Local Service Request Confirmation Form* -- Donor carrier confirms ported # and port due date.

3. Fields Used

Within the forms above there are many fields that do not apply to wireless, as the wireless network infrastructure is very different from the wireline side.

The table below contains the four potential LSR forms to be used by wireless carriers for Number Portability, and the corresponding fields on the form. On the right side of the table are two columns, wireless and wireline. The wireline values were taken directly from the OBF Form Preparation Guides. The values in the columns are as follows:

- *Required (R)* is defined as the field must be populated.
- *Optional (O)* is defined as the field may or may not be populated.
- *Prohibited (P)* is defined as the field must not be populated.
- *Conditional (C)* is defined as the field is dependent upon the relationship to another entry as specified in the usage statement and is dependent upon the presence, absence or combination of other data entries.
- *Not Used (N)* is defined as the field must not be populated by wireless carriers.

Further, an additional column has been added to indicate the type of data being provided. There are two types of data, the first type facilitates the process of exchanging or administering the LSR, the second type facilitates the process of porting subscribers (e.g., data used for the purpose of verifying or provisioning a subscriber). The values in the type column are as follows:

- *Porting (P)* is defined as a type of data that facilitates the porting process between carriers.
- *Administrative (A)* is defined as a type of data that facilitates the exchange or administration of the LSR process.

Field Abb.	Field #	Field Name	Wireless	Type	Wireline
Local Service Request Form					
Administrative Section (Fields 1-49)					
CCNA	1	Customer Carrier Name Abbreviation	R	A	R
PON	2	Purchase Order Number	R	A	R
VER	3	Version Identification	O	A	O
LSR NO	4	Local Service Request Number	N		C
AN	5	Account Number	C	A	C
ATN	6	Account Telephone Number	C	A	C
SC	7	Service Center	O	A	R
PG_of_	8	Page _ of	R	A	R
D/TSENT	9	Date and Time Sent	R	A	R
DDD	10	Desired Due Date	R	P	R
APPTIME (DDD)	11	Appointment Time	N		O
DDDO	12	Desired Due Date Out	N		C
APPTIME (DDDO)	13	Appointment Time	N		O
DFDT	14	Desired Frame Due Time	R	P	C
PROJECT	15	Project Identification	N		O
CHC	16	Coordinated Hot Cut	O	P	O
REQTYP	17	Requisition Type and Status	R	A	R
ACT	18	Activity	R	A	R
SUP	19	Supplement Type	C	A	C
EXP	20	Expedite	C	A	C
AFO	21	Additional Forms	C	A	C
RTR	22	Response Type Requested	R	A	R
CC	23	Company Code	C	A	C
AENG	24	Additional Engineering	N		O
ALBR	25	Additional Labor	N		O
SCA	26	Special Construction Authorization	N		O
AGAUTH	27	Agency Authorization Status	C	A	C
DATED	28	Date of Agency Authorization	C	A	C
AUTHNM	29	Authorization Name	O	A	O
ACTL	30	Access Customer Terminal Location	N		C
AI	31	Additional Point of Termination Indicator	N		C
APOT	32	Additional Point of Termination	N		C
LST	33	Local Service Termination	N		C
LSO	34	Local Serving Office	N		C
TOS	35	Type of Service	N		C
SPEC	36	Service and Product Enhancement Code	N		O

Field Abb.	Field #	Field Name	Wireless	Type	Wireline
NC	37	Network Channel Code	N		O
NCI	38	Network Channel Interface Code	N		C
CHANNEL	39	Channel	N		C
SECNCI	40	Secondary Network Channel Interface Code	N		C
RPON	41	Related Purchase Order Number	N		O
RORD	42	Related Order Number	N		C
LSP AUTH	45	Local Service Provider Authorization	N		O
LSP AUTH DATE	46	Local Service Provider Authorization Date	N		C
LSP AUTH NAME	47	Local Service Provider Authorization Name	N		C
CIC	48	Carrier Identification Code	N		O
CUST	49	Customer Name	C	A	C
Bill Section (Fields 50-68)					
BI1	50	Billing Account Number Identifier 1	C	A	C
BAN1	51	Billing Account Number 1	R	A	R
BI2	52	Billing Account Number Identifier 2	C	A	C
BAN2	53	Billing Account Number 2	C	A	C
ACNA	54	Access Customer Name Abbreviation	N		R
EBD	55	Effective Bill Date	N		O
BILLNM	56	Billing Name	N		C
SBILLNM	57	Secondary Billing Name	N		O
TE	58	Tax Exemption	N		C
EBP	59	Extended Billing Plan	N		O
STREET (BILLNM)	60	Street Address	N		C
FLOOR (BILLNM)	61	Floor	N		O
ROOM (BILLNM)	62	Room	N		O
CITY (BILLNM)	63	City	N		C
STATE (BILLNM)	64	State/Province	N		C
ZIP CODE (BILLNM)	65	Zip Code	N		C
BILLCON	66	Billing Contact	N		C
TEL NO (BILLNM)	67	Telephone Number	N		C
VTA	68	Variable Term Agreement	N		O
Contact Section (Fields 69-95)					
INIT	69	Initiator Identification	R	A	R
TEL NO (INIT)	70	Telephone Number	R	A	R
EMAIL (INIT)	71	Electronic Mail Address	O	A	O
FAX NO (INIT)	72	Facsimile Number	O	A	O
STREET (INIT)	73	Street Address	R	A	R
FLOOR (INIT)	74	Floor	O	A	O
ROOM/MAIL STOP	75	Room/Mail Stop	O	A	O

Field Abb.	Field #	Field Name	Wireless	Type	Wireline
(INIT)					
CITY (INIT)	76	City	R	A	R
STATE (INIT)	77	State/Province	R	A	R
ZIP CODE (INIT)	78	Zip Code	R	A	R
IMPCON	79	Implementation Contact	N		O
TEL NO (IMPCON)	80	Telephone Number	N		C
PAGER (IMPCON)	81	Pager Number	N		O
ALT IMPCON	82	Alternate Implementation Contact	N		O
TEL NO (ALT IMPCON)	83	Telephone Number	N		C
PAGER (ALT IMPCON)	84	Pager Number	N		O
DSGCON	85	Design/Engineering Contact	N		O
DRC	86	Design Routing Code	N		O
TEL NO (DSG)	87	Telephone Number	N		C
FAX NO (DSG)	88	Facsimile Number	N		O
EMAIL (DSG)	89	Electronic Mail Address	N		O
STREET (DSG)	90	Street Address	N		C
FLOOR (DSG)	91	Floor	N		O
ROOM/MAIL STOP (DSG)	92	Room/Mail Stop	N		O
CITY (DSG)	93	City	N		C
STATE (DSG)	94	State/Province	N		C
ZIP CODE (DSG)	95	Zip Code	N		C
Remarks Section (Field 96)					
REMARKS	96	Remarks	O	A	O
End User Information Form					
Administrative Section (Fields 1-6)					
PON	1	Purchase Order Number	R	A	R
VER	2	Version Identification	O	A	O
AN	3	Account Number	C	A	C
ATN	4	Account Telephone Number	C	A	C
DQTY	5	Disconnect Quantity	N		C
PG_of_	6	Page _ of _	R	A	R
Location and Address Section (Fields 7-29)					
NAME	7	End User Name	R	P	R
SAPR	9	Service Address House Prefix	N		C
SANO	10	Service Address House Number	N		C
SASF	11	Service Address House Number Suffix	N		C
SASD	12	Service Address Street Directional	N		O

Field Abb.	Field #	Field Name	Wireless	Type	Wireline
SASN	13	Service Address Street Name	R	P	R
SATH	14	Service Address Thoroughfare	N		C
SASS	15	Service Address Street Suffix	N		C
SADLO	16	Service Address Descriptive Location	N		O
FLOOR (END USER)	17	Floor	O	P	O
ROOM (END USER)	18	Room	O	P	O
BLDG	19	Building	N		O
CITY (END USER)	20	City	R	P	R
STATE (END USER)	21	State/Province	R	P	R
ZIP CODE (END USER)	22	Zip Code	R	P	R
LCON	23	Local Contact	N		O
TEL NO (LCON)	24	Telephone Number	N		O
EUMI	25	End User Moving Indicator	N		O
ACC	26	Access Information	N		O
WSOP	27	Working Service on Premises	N		O
CPE MFR	28	Customer Premises Equipment Manufacturer	N		O
CPR MOD	29	Customer Premises Equipment Model Number	N		O
Inside Wire Section (Fields 30 - 33)					
IWO	30	Inside Wiring Options	N		O
IWBAN	31	Inside Wire Bill Account Number	N		O
IWCON	32	Inside Wire Contact	N		C
TEL NO (IWCON)	33	Inside Wire Contact Telephone Number	N		C
Bill Section (Fields 35 - 48)					
EAN	35	Existing Account Number	N		C
EATN	36	Existing Account Telephone Number	R	A	C
FBI	37	Final Bill Information Indicator	N		O
BILLNM	38	Bill Name	N		C
SBILLNM	39	Secondary Billing Name	N		O
STREET (BILLNM)	40	Street Address	N		C
FLOOR (BILLNM)	41	Floor	N		O
ROOM (BILLNM)	42	Room	N		O
CITY (BILLNM)	43	City	N		C
STATE (BILLNM)	44	State/Province	N		C
ZIP CODE (BILLNM)	45	Zip Code	N		C
BILLCON	46	Billing Contact	N		C

Field Abb.	Field #	Field Name	Wireless	Type	Wireline
TEL NO (BILLCON)	47	Telephone Number	N		C
SSN	48	Social Security Number	N		O
Disconnection Information Section (Fields 49 - 54)					
REF NUM	49	Reference Number	N		C
DISC #	50	Disconnect Telephone Number	N		C
TER	51	Terminal Number	N		O
TC OPT	52	Transfer of Call Options	N		O
TC TO	53	Transfer of Calls To	N		C
TC PER	54	Transfer of Calls Period	N		C
Remarks Section (Field 55)					
REMARKS	55	Remarks	O	A	O
Number Portability Form					
Administrative Section (Fields 1-6)					
PON	1	Purchase Order Number	R	A	R
VER	2	Version Identification	O	A	O
AN	3	Account Number	C	A	C
ATN	4	Account Telephone Number	C	A	C
NPQTY	5	Number Portability Quantity	R	A	R
PG_of_	6	Page _ of _	R	A	R
Service Details Section (Fields 7-25)					
REF NUM	7	Reference Number	R	A	R
CKR	8	Customer Circuit Reference	N		O
LNA	9	Line Activity	R	A	R
LRN	10	Location Routing Number	O	P	O
TDT	11	Ten Digit Trigger	O	P	O
ECCKT	12	Exchange Company Circuit ID	N		O
PORTED #	13	Ported Telephone Number	R	A	R
TNP	14	Total Number of Paths	N		C
CFTN	15	Call Forward To Number	N		C
NPT	16	Number Portability Type	R	P	C
RTI	17	Route Index	N		O
NPTG	18	Number Portability Trunk Group	N		O
BA	19	Blocking Activity	N		C
BLOCK	20	Block	N		O
FPI	21	Freeze PIC Indicator	N		O
LPIC	22	IntraLATA Presubscription Indicator Code	N		O
TC OPT	23	Transfer of Call Options	N		O
TC TO	24	Transfer of Calls To	N		C
TC PER	25	Transfer of Calls Period	N		C

Field Abb.	Field #	Field Name	Wireless	Type	Wireline
Remarks Section (Field 26)					
REMARKS	26	Remarks	N	A	O
Local Service Request Confirmation Form					
Administrative Section (Fields 1-27)					
CCNA	1	Customer Carrier Name Abbreviation	R	A	R
PON	2	Purchase Order Number	R	A	R
VER	3	Version Identification	O	A	O
AN	4	Account Number	C	A	C
ATN	5	Account Telephone Number	C	A	C
LSR NO	6	Local Service Request Number	N		O
ORD	7	Order Number	N		O
INIT	8	Initiator Identification	R	A	R
PG_of_	9	Page _ of _	R	A	R
CD/TSENT	10	Confirmation Date and Time Sent	R	A	R
REP	11	Provider Contact Representative	R	A	R
ST	12	Switch Type	N		C
IBT	13	ISDN BRI Type	N		O
TEL NO	14	Telephone Number	R	A	R
CN TYP	15	Confirmation Type	R	A	R
CHC	16	Coordinated Hot Cut	O	P	O
FDT	17	Frame Due Time	R	P	C
DD	18	Due Date	R	P	R
EBD	19	Effective Bill Date	N		O
BI1	20	Billing Account Number Identifier 1	O	A	C
BAN1	21	Billing Account Number 1	R	A	C
BI2	22	Billing Account Number Identifier 2	O	A	C
BAN2	23	Billing Account Number 2	O	A	C
EC VER	24	Exchange Carrier Version	C	A	C
DSGCON	25	Design/Engineering Contact	N		O
NSP DSGCON	26	Network Service Provider (NSP) Design/Engineering Contact	N		O
TEL NO (NSP DSGCON)	27	Telephone Number	N		C
Line/Network Information Section (Fields 28-53)					
REF NUM	28	Reference Number	R	A	C
RNEX	29	Reference Number Extension	N		C
ECCKT	30	Exchange Company Circuit ID	N		C
TN	31	Telephone Number	N		C
MATN	32	Main/Alternate Telephone Number	N		O
CKR	33	Customer Circuit Reference	N		O

Field Abb.	Field #	Field Name	Wireless	Type	Wireline
ISPID	34	ISDN Service Profile Identification	N		C
CFA	35	Connecting Facility Assignment	N		C
LORD	36	Loop Order Number	N		C
NPORD	37	Number Portability Order Number	N		C
PORTED #	38	Ported Telephone Number	R	P	R
RTI	39	Route Index	N		C
DISC #	40	Disconnect Telephone Number	N		C
TER	41	Terminal Number	N		C
DISC ORD	42	Disconnect Order Number	N		O
SYSTEM ID	43	System Identification	N		C
CABLE ID	44	Cable Identification CC 61 Company Code	N		C
SHELF	45	Shelf	N		C
SLOT	46	Slot	N		C
RELAY RACK	47	Relay Rack	N		C
CHAN/PAIR	48	Channel/Pair	N		R
UNIT	49	Unit	N		O
PGI	50	Pair Gain Indicator	N		C
DEMARC	51	Demarc Designation	N		C
OOR	52	Out of Range Indicator	N		C
NID	53	Network Interface Device	N		C
SELOC Section (Fields 54-58)					
VC NUM	54	Virtual Connection Number	N		C
DLCI	55	Data Link Connection Identifier	N		C
RECCKT	56	Related Exchange Company Circuit Identification	N		C
LST	57	Local Service Termination	N		C
RDLCI	58	Related Data Link Connection Identifier	N		C
Directory Section (Fields 59-80)					
ATN	59	Account Telephone Number	N		R
DCNR	60	Directory Confirmation Type Returned	N		R
CCNA	61	Company Code	N		C
DOR	62	Date of Receipt	N		R
DLORD	63	Directory Listing Order Number	N		O
DAORD	64	Directory Assistance Order Number	N		O
DSR NO	65	Directory Service Request Number	N		C
DDA	66	Date of Availability in DA	N		R
DINIT	67	Directory Request Initiator	N		R
DCHC	68	Directory Assistance Coordinated Hot Cut	N		O
DADT	69	Directory Assistance Due Time	N		C
DBI1	70	Directory Billing Account Number Identifier 1	N		C

Field Abb.	Field #	Field Name	Wireless	Type	Wireline
DBAN1	71	Directory Billing Account Number 1	N		C
DBI2	72	Directory Billing Account Number Identifier 2	N		C
DBAN2	73	Directory Billing Account Number 2	N		C
DLCONT INIT	74	Name of Contact at Providing Company	N		O
DLCONT TN	75	Directory Contact Telephone Number	N		C
DACONT INIT	76	Name of Contact at Providing Company	N		O
DACONT TN	77	Directory Contact Telephone Number	N		C
LQTYR	78	Number of Listings Received	N		R
SQTYR	79	Service Address Quantity Received	N		R
DDQTYR	80	Number of Delivery Segments Received	N		C
Remarks Section (Field 81)					
REMARKS	81	Remarks	O	A	O

Appendix C: Acronyms

<i>Acronym</i>	<i>Expansion</i>
ACG	Automatic Code Gap
AIN	Advanced Intelligent Network
AMA	Automatic Message Accounting
AMPS	Advanced Mobile Phone System
CC	Customer Care
CCPN	Call Completion to a Ported Number
CDMA	Code Division Multiple Access
CdPA	Called Party Address
CdPN	Called Party Number
CDR	Call Detail Record
CFNA	Call Forward No Answer
CgPA	Calling Party Address
CgPN	Calling Party Number
CHN	Charge Number
CLASS	Custom Local Area Signaling Services
CMIP	Common Management Interface Protocol
CMRS	Commercial Mobile Radio Service
CNAM	Calling Name
CORD	Cellular Operations Record Distribution
CTIA	Cellular Telecommunications Industry Association
DN	Directory Number
EDI	Electronic Data Interchange
EO	End Office
ESN	Electronic Serial Number
ESP	Emergency Service Provider
FCC	Federal Communications Commission
FCI	Forward Call Indicator
FGD	Feature Group D
FOC	Firm Order Confirmation
GAP	Generic Address Parameter
GSM	Global System for Mobile Communications
GTT	Global Title Translation
HLR	Home Location Register
IAM	Initial Address Message
IMSI	International Mobile Station Identifier (E.212)
IN	Intelligent Network
IS-41	Interim Standard - 41
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
IXC	Inter Exchange Carrier
LATA	Local Access Transport Area
LEC	Local Exchange Carrier

<i>Acronym</i>	<i>Expansion</i>
LERG	Local Exchange Routing Guide
LIDB	Line Information Database
LRN	Location Routing Number
LSMS	Local Service Management System
LSP	Local Service Provider
MC	Message Center
MCC	Mobile Country Code
MDN	Mobile Directory Number
MIN	Mobile Identification Number
MNC	Mobile Network Code
MS	Mobile Station
MSA	Metropolitan Statistical Area
MSC	Mobile Switching Center
MSID	Mobile Station Identifier
MSIN	Mobile Station Identification Number (as part of IMSI)
MTP	Message Transfer Part
NANC	North American Numbering Council
NANP	North American Numbering Plan
NE	Network Element
NP	Number Portability
NP DB	Number Portability Database
NPAC-SMS	Number Portability Administrative Center Service Management System
NPRM	Notice of Proposed Rulemaking
O-MSC	Originating Mobile Switching Center
OAM&P	Operations, Administration, Maintenance, and Provisioning
OBF	Ordering and Billing Forum
OEO	Originating End Office
OSS	Operations Support System
OTAF	Over The Air Function
PC	Point Code
PODP	3/6/10 Digit Public Office Dialing Plan
POI	Point of Interconnection
POP	Point of Presence
PSTN	Public Switched Telecommunications Network
RBOC	Regional Bell Operating Company
RN	Routing Number
SCCP	Signaling Connection Control Part
SCPs	Service Control Points
SK	Service Key
SME	Short Message Entity
SMR	Specialized Mobile Radio
SMS	Service Management System
SMS	Short Message Service
SOA	Service Order Activation
SP	Service Provider
SS7	Signaling System 7

<i>Acronym</i>	<i>Expansion</i>
SSN	Sub-System Number
STP	Signal Transfer Point
TCAP	Transaction Capabilities Application Part
TCPN	Translated Called Party Number
TDMA	Time Division Multiple Access
TEO	Terminating End Office
TLDN	Temporary Local Directory Number
TT	Translation Type
V-MSC	Visited Mobile Switching Center
VLR	Visiting Location Register
WIN	Wireless Intelligent Network
WNP	Wireless Number Portability
WSP	Wireless Service Provider